

3GPP2 X.S0059-400-0

Version 1.0

Date: December 2011



3RD GENERATION
PARTNERSHIP
PROJECT 2
"3GPP2"

cdma2000 Femtocell Network: 1x Supplementary Service Aspects

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Revision History

Revision	Description of Changes	Date
Rev. 0 v1.0	Initial Publication	December 2011

cdma2000 Femtocell Network: 1x Supplementary Service Aspects

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Table 1	Timer Values	49
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FOREWORD

(This foreword is not part of this specification.)

This document was prepared by the Third Generation Partnership Project 2 (3GPP2) TSG-X Working Group.

This document is a new specification.

This document is part of a multi-part document. The multiple parts together specify the cdma2000®¹ Femtocell Network.

This document is subject to change following formal approval procedures. Should this document be modified in the future, it will be re-released with a change-of-release date and an identifying change in version number as follows:

X.S0059-400-X-n

where:

- X: a numerical or uppercase alphabetic character [A, B, C, ...] that indicates the revision level;
- n: a numeric string [1, 2, 3, ...] that indicates the point release level.

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1 Introduction

1.1 Scope

This document defines the Stage 2 service descriptions, call flows and normative Stage 3 procedures that provide cdma2000 1x circuit-switched Supplementary Services to the MS through the IMS core network when the MS is camped on a Femtocell Access Point (FAP).

Specifically, 1x Supplementary Services are provided to an MS that is attached to a FAP using the cdma2000 1x radio interface. The MS is homed in the 1x circuit-switched domain, and is registered in the 1x HLR. The system takes advantage of IMS functionality to provide subscribed services.

1.2 Document Conventions

“Shall” and “shall not” identify requirements to be followed strictly to conform to this document and from which no deviation is permitted. “Should” and “should not” indicate that one of several possibilities is recommended as particularly suitable, without mentioning or excluding others, that a certain course of action is preferred but not necessarily required, or that (in the negative form) a certain possibility or course of action is discouraged but not prohibited. “May” and “need not” indicate a course of action permissible within the limits of the document. “Can” and “cannot” are used for statements of possibility and capability, whether material, physical or causal.

2 References

2.1 Normative References

This section provides references to other specifications and standards that are necessary to implement this document.

- [A.S0014] 3GPP2 A.S0014-D v2.0, “Interoperability Specification (IOS) for cdma2000 Access Network Interfaces - Part 4 (A1, A1p, A2, and A5 Interfaces)”; August 2009.
- [C.S0005] 3GPP2 C.S0005-0 v3.0, “Upper Layer (Layer 3) Signaling Standard for cdma2000 Spread Spectrum Systems”; June 2000.
- [RFC 2976] IETF RFC 2976, “The SIP Info Method”; October 2000.
- [RFC 3261] IETF RFC 3261, “SIP: Session Initiation Protocol”; June 2002.
- [RFC 3262] IETF RFC 3262, “Reliability of Provisional Responses in the Session Initiation Protocol (SIP)”; June 2002.
- [RFC 3264] IETF RFC 3264, “An Offer/Answer Model with the Session Description Protocol (SDP)”; June 2002.
- [RFC 3326] IETF RFC 3326, “The Reason Header Field for the Session Initiation Protocol (SIP)”; December 2002.
- [RFC 3966] IETF RFC 3966, “The tel URI for Telephone Numbers”; December 2004.
- [RFC 4240] IETF RFC 4240, “Basic Network Media Services with SIP,”; December 2005.
- [TS 24.229] 3GPP TS 24.229 v9.3.0, “Internet Protocol (IP) multimedia call control protocol based on Session Initiation Protocol (SIP) and Session Description Protocol (SDP); Stage 3”; March, 2010.
- [TS 29.163] 3GPP TS 29.163 v7.2.0, “Interworking between the IP Multimedia (IM) Core Network (CN) subsystem and Circuit Switched (CS) networks”; March, 2006.
- [X.S0059-000] 3GPP2 X.S0059-000-0 v1.0, “cdma2000 Femtocell Network: Overview and List of Parts”; January, 2010.
- [X.S0059-200] 3GPP2 X.S0059-200-0 v1.0, “cdma2000 Femtocell Network: 1x and IMS Network Aspects”; January, 2010.
- [X.S0004-322] 3GPP2 X.S0004-322-E v1.0, “Mobile Application Part (MAP) – Voice Feature Scenarios: Call Forwarding”; January 2007.
- [X.S0004-324] 3GPP2 X.S0004-324-E v2.0, “Mobile Application Part (MAP) – Voice Feature Scenarios: Calling Number Identification Presentation, Calling Number Identification Restriction”; December 2008.
- [X.S0004-329] 3GPP2 X.S0004-329-E v1.0, “Mobile Application Part (MAP) – Voice Feature Scenarios: Message Waiting Notification”; April 2008.

3 Definitions, Abbreviations and Acronyms

This section contains definitions and acronyms that are used throughout the document.

3.1 Definitions

This document conforms to the definitions contained in [X.S0059-000].

3.2 Abbreviations and Acronyms

This section provides a definition of the abbreviations used within this recommendation, as:

AuC	Authentication Center
B2BUA	Back To Back User Agent
CDMA	Code Division Multiple Access
CSCF	Call Session Control Function
FAP	Femtocell Access Point
FCS	Femtocell Convergence Server
HLR	Home Location Register
I-CSCF	Interrogating CSCF
IMS	IP Multimedia Subsystem
IOS	Interoperability Specification
IP	Internet Protocol
IPsec	IP security
MGCF	Media Gateway Control Function
MGW	Media Gateway
MIN	Mobile Identification Number
MPC	Mobile Positioning Center
MRF	Media Resource Function
MS	Mobile Station / User Equipment / Access Terminal
MSC	Mobile Switching Center
P-CSCF	Proxy-CSCF
PSTN	Public Switched Telephone Network
S-CSCF	Serving CSCF
SIP	Session Initiation Protocol
TLDN	Telephone Location Directory Number
URI	Uniform Resource Identifier
VLR	Visited Location Register

4 Architectural Model and Reference Points

The architectural model and reference points to access circuit-switched and packet-switched services from a FAP are described in [X.S0059-000].

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5 Informational Flows

5.1 Overview

The following subsections contain informational flows that illustrate the provision of supplementary services via 1x femtocell. Assumptions that apply to the various scenarios are listed as appropriate. Unless otherwise noted, the scenarios in this section depict features operating individually (i.e., feature interactions are not considered unless specifically noted). The scenarios in this section do not include a complete list of operation parameters, either in the figures or in the accompanying text descriptions; parameters are included where they are deemed necessary to improve the understanding of the scenario. For brevity, the SIP 100 (Trying) response is not shown; however, the requirement for sending a SIP 100 (Trying) response, as defined in [RFC 3261], still applies.

5.2 Line ID Services

5.2.1 Calling Number Identification Presentation (CNIP)

5.2.1.1 CNIP Invocation to an Idle Subscriber

The following informational flow illustrates the application of Calling Number Identification Presentation to a call terminating at an idle 1x MS that is registered with a FAP (see Figure 1 of [X.S0004-324]).

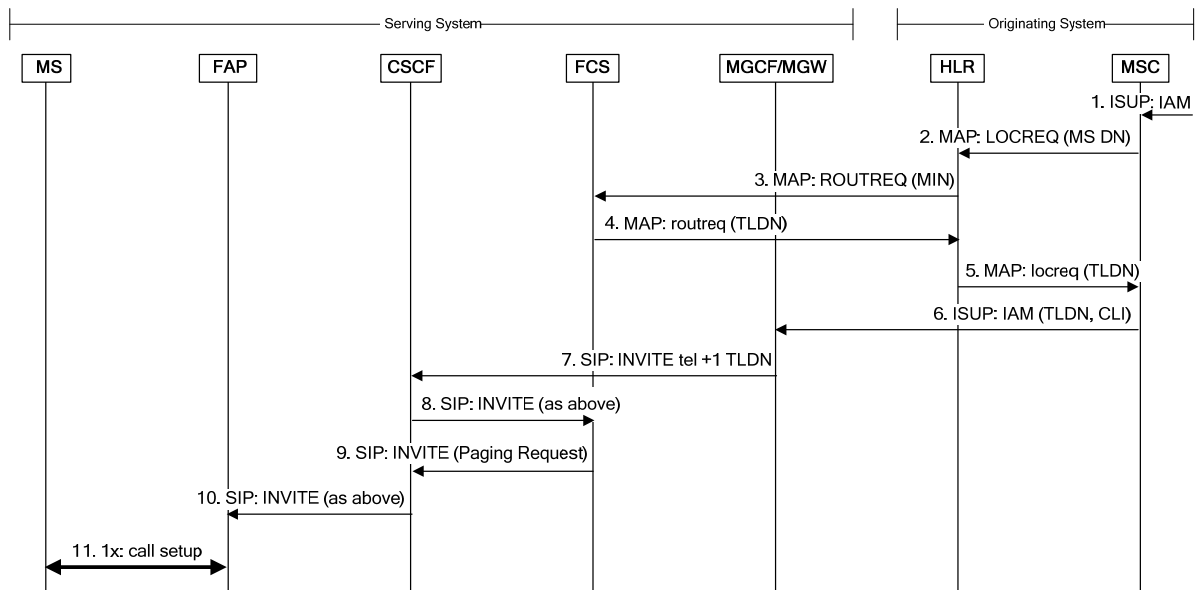


Figure 1 CNIP Invocation to an Idle Subscriber

Preconditions: The FAP has previously connected to the network, set up the IPsec tunnel and is IMS registered. The MS has previously registered and the FCS has a VLR entry for this subscriber. A caller dials the CDMA user's mobile directory number, which is routed to the user's home (originating) MSC.

1. The Originating MSC receives a call origination. 1
2. The Originating MSC sends a LocationRequest INVOKE to the HLR associated with the MS; this association is made through the dialed MS address digits (which may not be the same as the MIN). 2
3. If the dialed MS address digits are assigned to a valid subscriber, the HLR sends a RoutingRequest INVOKE to the FCS where the MS is registered. 3
- 4-5. The FCS allocates a TLDN which is in the range of the public service IDs (PSI) assigned to this FCS. The FCS stores the temporary association between the called party and the TLDN. The FCS returns the TLDN to the Originating MSC. 4
6. The incoming call is routed to the MGCF/MGW via the TLDN. The Calling Party Number of the OEP is included as a CLI parameter in the ISUP IAM. 5
- 7-8. The MGCF/MGW converts the incoming call to a SIP INVITE request, including the Calling Party Number in the P-Asserted-Identity header field, and sends it to the CSCF which routes it to the FCS. 6
- 9-10. The FCS retrieves the called party information associated with the TLDN and replaces the Request-URI with the FAP currently serving that user and populates the To header with the mobile directory number in tel URI format, [RFC 3966]. If the user subscribes to CNIP, the FCS includes the received P-Asserted-Identity header field. The FCS sends the SIP INVITE request to the CSCF, which routes it to the FAP. 7
11. Call setup involves the exchange of Page Request/Response and traffic channel assignment messages among the MS, FAP and FCS (see Figure 8 of [X.S0059-200]). Once the traffic channel has been established with the MS, the Calling Party Number is delivered to the MS in an Alert With Information message (not shown). 8

5.2.2 Calling Number Identification Restriction (CNIR) 9

5.2.2.1 CNIR Invocation 10

The following informational flow illustrates CNIR in a permanent mode by an authorized 1x MS that is registered with a FAP. Permanent mode implies that CNIR is always on based on the subscriber profile downloaded from the HLR at registration. 11

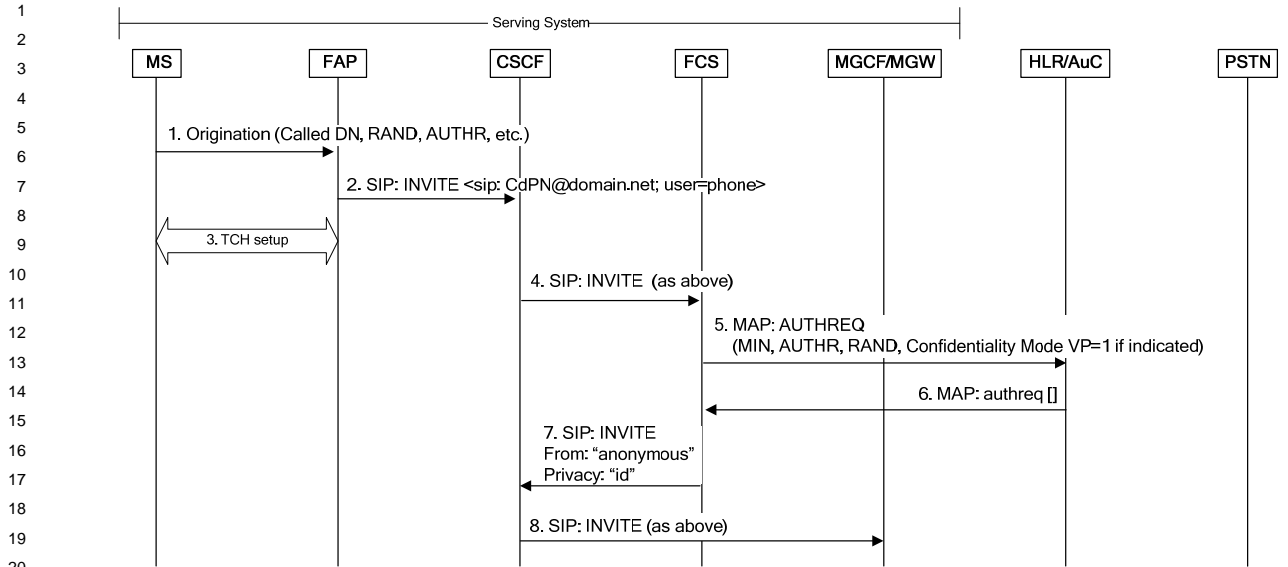


Figure 2 CNIR Invocation

Preconditions: The FAP has previously connected to the network, set up the IPsec tunnel and completed IMS registration. The MS has previously registered with the HLR. The FAP is broadcasting a global challenge. The mobile user initiates a call.

1. The call origination (including global challenge response) is signaled over the air to the FAP.
2. The FAP translates the origination into a SIP INVITE request and includes specified fields in the body of the SIP INVITE request, which it then sends to the CSCF. If available, the calling mobile directory number is included in tel URI format [RFC 3966] in the From header.
3. Anytime after receiving the 1x Origination in Step 1 (but prior to Step 14 in Figure 7 of [X.S0059-200]), the FAP establishes the traffic channel with the MS per the information received on the 1x Origination message from the MS and the capabilities/bandwidth availability at the FAP.
4. The CSCF sends the SIP INVITE request to the FCS per the filter criteria for originations.
5. The FCS initiates CDMA device authentication by sending an AuthenticationRequest INVOKE to the AuC.
6. The AuC responds with the authentication result. If the result is successful, the call setup is allowed. If authentication fails, the FCS rejects the mobile origination attempt.
- 7-8. Assuming authentication is successful; the FCS analyzes the dialed digits and if CNIR is subscribed then the FCS anonymizes the From header and the Privacy header. The SIP INVITE request is then sent to the CSCF and delivered to the MGCF for completion of call setup.

5.2.2.2 CNIR Temporary Activation or De-Activation with Call

The following informational flow illustrates the temporary mode activation (or de-activation) of CNIR by an authorized 1x MS that is registered with a FAP (see Figure 7 of [X.S0004-324]).

5.3 Communication Diversion Service

5.3.1 Call Forwarding-Busy (CFB)

5.3.1.1 CFB Invocation

The following flow illustrates CFB invocation due to the served MS being busy, for a 1x MS attached to a FAP (see also Figure 1 of [X.S0004-322]).

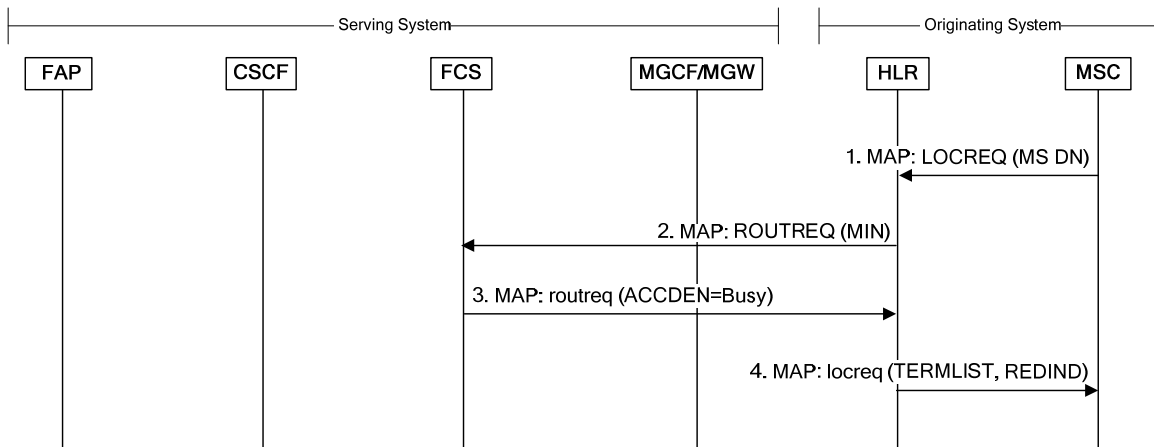


Figure 3 Call Forwarding-Busy (CFB) Invocation

Preconditions: The FAP has previously connected to the network, set up the IPsec tunnel and completed IMS registration. As part of the IMS registration, the initial filter criteria include the FCS application server in SIP INVITE, REGISTRATION, and MESSAGE transactions. A caller dials the CDMA user's mobile directory number, which is routed to the user's home (originating) MSC. The called party is currently on another call and has Call Forward Busy activated.

1. The Originating MSC sends a LocationRequest INVOKE to the HLR associated with the MS; this association is made through the dialed MS address digits (which might not be the same as the MIN).
2. If the dialed MS address digits are assigned to a legitimate subscriber, the HLR sends a RoutingRequest INVOKE to the FCS where the MS is registered.
3. In reaction to the RoutingRequest INVOKE, the FCS checks its internal data structures and determines that the MS is busy in another call. The status of the MS is returned by the FCS in the RoutingRequest RETURN RESULT.
4. The HLR determines from the service profile that CFB is active. It sends a LocationRequest RETURN RESULT to the Originating MSC providing the forward-to number and other routing information in the TerminationList parameter, along with an indication of the reason for extending the incoming call (i.e., for CFB) in the DMH_RedirectionIndicator parameter.

5.3.1.2 CFB Invocation with Call Collision

This scenario describes call delivery to a 1x MS attached to a FAP that has CFB active and becomes engaged in a call at the same time that the originating MSC is delivering a call to the FCS (see also Figure 2 of [X.S0004-322]).

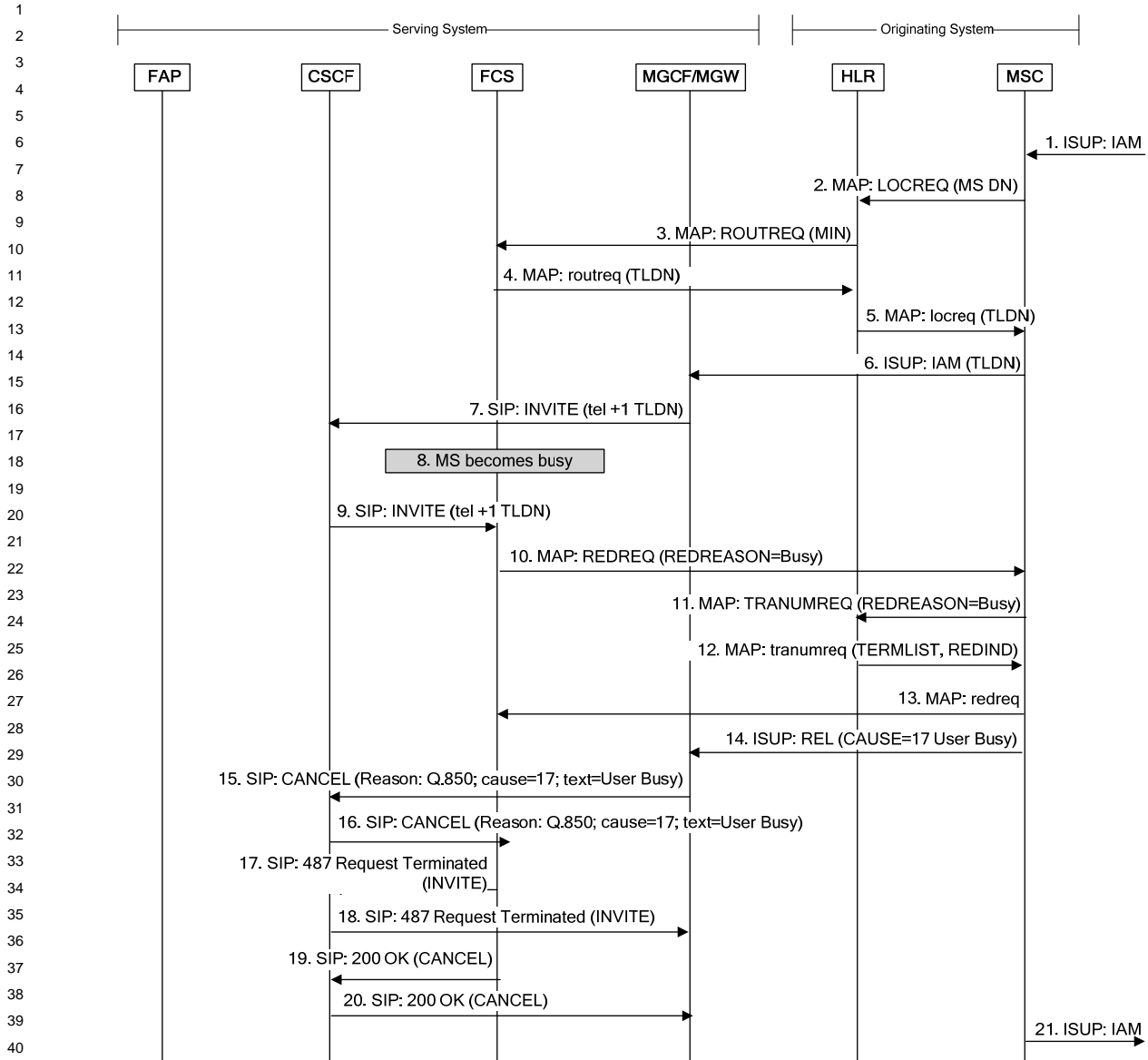


Figure 4 Call Forwarding-Busy (CFB) Invocation with Call Collision

1. The Originating MSC receives a call origination.
2. The Originating MSC sends a LocationRequest INVOKE to the HLR.
3. The HLR sends a RoutingRequest INVOKE to the FCS for which the subscriber is registered. The FCS allocates a TLDN which is in the range of the public service IDs (PSI) assigned to the FCS. The FCS binds the TLDN with the called party.
- 4-5. The TLDN is returned to the Originating MSC.
6. Based on the TLDN, the call origination is routed to the MGCF/MGW.
7. The MGCF converts the incoming call to a SIP INVITE request and routes the call to the I-CSCF.

8. Sometime after the FCS sends the RoutingRequest RETURN RESULT (Step 4) back to the HLR, the MS becomes engaged in another call. This may be the result of an MS origination.
9. The I-CSCF routes the SIP INVITE request to the S-CSCF which routes the SIP INVITE request to the FCS. The FCS retrieves the called party information associated with the TLDN. The FCS determines that the MS is busy in another call.
10. The FCS then sends a RedirectionRequest INVOKE to the Originating MSC, indicating that the call is being redirected due to a “busy” condition.
11. The Originating MSC is able to redirect the call, therefore it sends a TransferToNumberRequest INVOKE to the HLR requesting the forward-to number appropriate for this condition from the MS’s service profile.
12. The HLR sends the TransferToNumberRequest RETURN RESULT to the Originating MSC, including the appropriate forward-to number in the TerminationList parameter, along with an indication of the reason for extending the incoming call (i.e., for CFB) in the DMH_RedirectionIndicator parameter.
13. When the TransferToNumberRequest RETURN RESULT is received from the HLR, the Originating MSC sends a RedirectionRequest RETURN RESULT to the FCS.
14. The Originating MSC releases the voice path and sends an ISUP Release message, with “Cause=17 User Busy”, to the MGCF/MGW.
- 15-16. The MGCF/MGW maps the ISUP Release to a SIP CANCEL request [TS 29.163]. The Reason header is set to “Reason: Q.850; cause=17; text=User Busy” [TS 29.163] [RFC 3326]. The MGCF/MGW sends the SIP CANCEL to the FCS.
- 17-18. The FCS sends a SIP 487 (Request Terminated) response to the MGCF/MGW. The SIP 487 (Request Terminated) response is a response to the SIP INVITE request.
- 19-20. The FCS answers the SIP CANCEL request by sending a SIP 200 (OK) response to the MGCF/MGW.
21. The Originating MSC then establishes a call to the specified forward-to number.

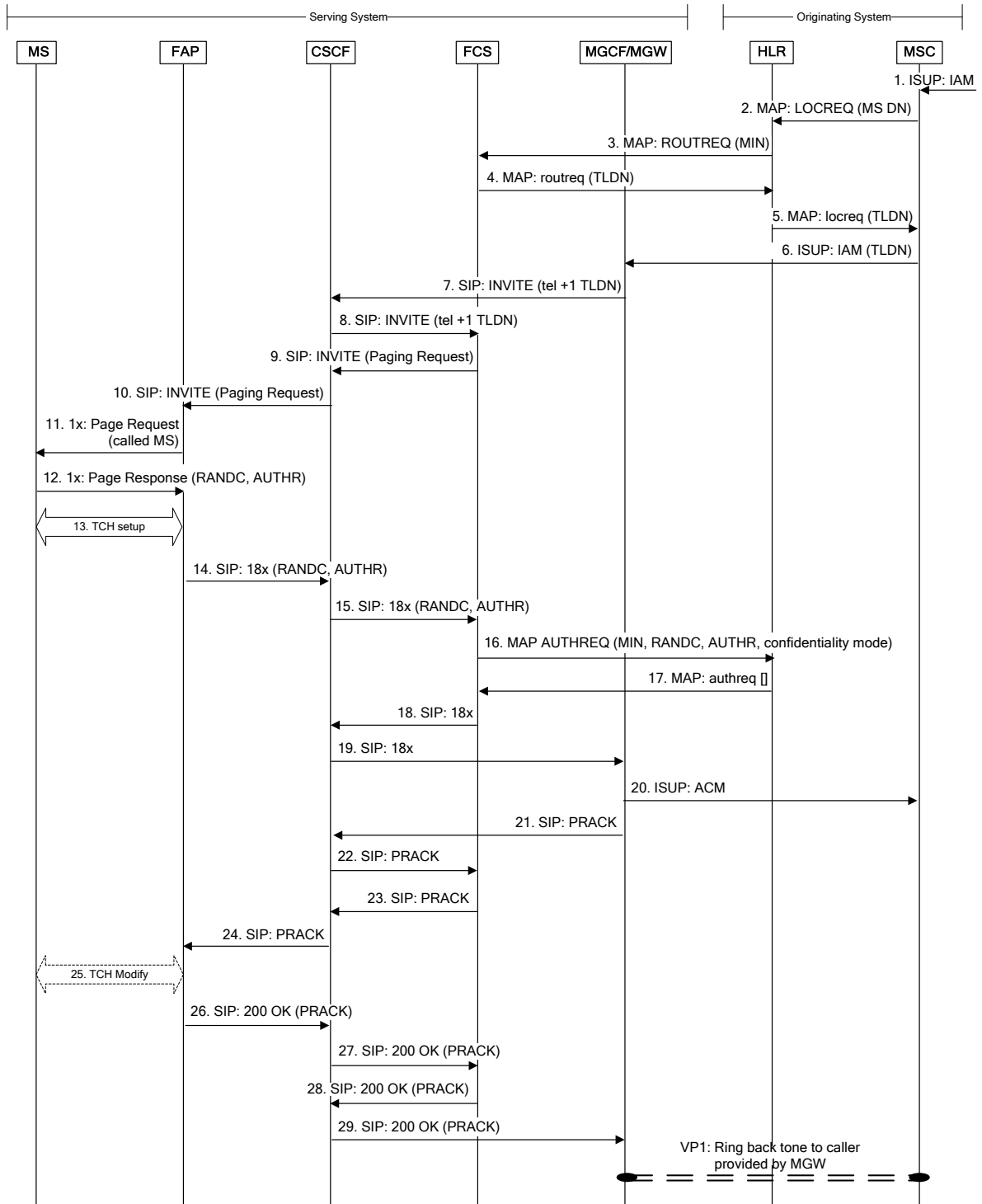
5.3.2 Call Forwarding–Default (CFD)

Two scenarios are shown: one in which the MS does not respond to the page request, and one in which the MS responds to the page but the MS user does not answer the alert.

5.3.2.1 CFD Invocation with No Answer

The following flow illustrates CFD invocation due to the MS not answering, for a 1x MS attached to a FAP (see Figure 4 of [X.S0004-322]).

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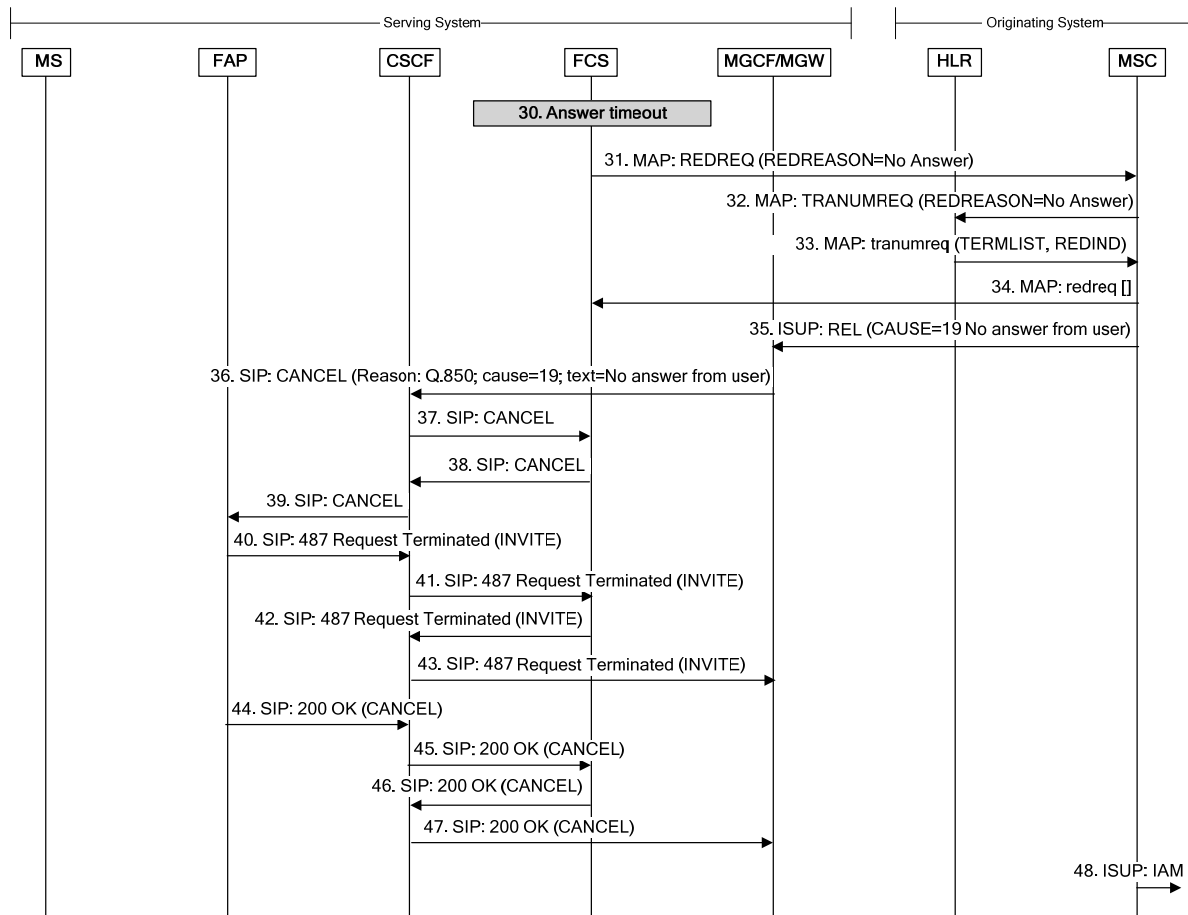


Figure 5 Call Forwarding-Default (CFD) Invocation with No Answer

1. The Originating MSC receives a call origination.
2. The Originating MSC sends a LocationRequest INVOKE to the HLR.
3. The HLR sends a Routing Request INVOKE to the FCS at which the subscriber is registered.
- 4-5. The FCS allocates a TLDN which is in the range of the public service IDs (PSI) assigned to this FCS. The FCS stores the temporary association between the called party and the TLDN. The FCS returns the TLDN to the Originating MSC.
6. The incoming call is routed to the MGCF/MGW via the TLDN.
7. The MGCF/MGW converts the incoming call to a SIP INVITE request and sends it to the CSCF for delivery to the FCS.
8. The FCS retrieves the called party information associated with the TLDN and replaces the Request-URI with the FAP currently serving that user and populates the To header with the mobile directory number in tel URI format [RFC 3966]. The FCS sends the SIP INVITE request to the S-CSCF for that FAP.
- 9-10. The S-CSCF routes the SIP INVITE request to the FAP.
11. The FAP pages the MS identified in the To header.

- 1 12. The MS responds to the page including the global challenge response.
- 2
- 3 13. The FAP may establish the traffic channel with the MS anytime after receiving the Page
- 4 Response from the MS and before responding to the SIP PRACK request (Step 26) from
- 5 the FCS.
- 6
- 7 14-15. The FAP includes the global challenge response parameters in the SIP 18x response to
- 8 the FCS.
- 9
- 10 16. The FCS may initiate authentication of the MS by sending an AuthenticationRequest
- 11 INVOKE to the AuC.
- 12
- 13 17. TheAuC responds with the authentication result; assuming success, the call is allowed to
- 14 continue. If authentication fails the incoming call is redirected to the called party's voice
- 15 mail.
- 16
- 17 18-19. The FCS forwards the SIP 18x response to the MGCF.
- 18
- 19 20. Upon receiving SIP 18x, the MGCF/MGW sends the ISUP Address Complete Message
- 20 to the Originating MSC.
- 21
- 22 21-24. The MGCF responds to the SIP 18x with SIP PRACK request, which is delivered to the
- 23 FCS.
- 24
- 25 25. The FAP completes traffic channel establishment with the MS and sends an alert message
- 26 to the MS (not shown).
- 27
- 28 26-29. The FAP responds to the SIP PRACK request with SIP 200 (OK) response, which is
- 29 delivered to the MGCF.
- 30
- 31 30. The mobile user does not answer the alert.
- 32
- 33 31. The FCS then sends a RedirectionRequest INVOKE to the Originating MSC, indicating
- 34 that the call is being redirected due to a "no answer" condition.
- 35
- 36 32. The Originating MSC is able to redirect the call, therefore, it sends a
- 37 TransferToNumberRequest INVOKE to the HLR requesting the forward-to number
- 38 appropriate for this condition from the MS's service profile.
- 39
- 40 33. The HLR sends the TransferToNumberRequest RETURN RESULT to the Originating
- 41 MSC, including the appropriate forward-to number in the TerminationList parameter,
- 42 along with an indication of the reason for extending the incoming call (i.e., for CFD) in
- 43 the DMH_RedirectionIndicator parameter.
- 44
- 45 34. When the TransferToNumberRequest RETURN RESULT is received from the HLR, the
- 46 Originating MSC sends a RedirectionRequest RETURN RESULT to the FCS.
- 47
- 48 35. The Originating MSC releases the voice path and sends an ISUP Release message, with
- 49 "Cause=19 No answer from user", to the MGCF/MGW.
- 50
- 51 36-39. The MGCF/MGW maps the ISUP Release to a SIP CANCEL [TS 29.163]. The Reason
- 52 header is set to "Reason: Q.850; cause=19; text=No answer from user" [TS 29.163]
- 53 [RFC 3326]. The MGCF/MGW sends the SIP CANCEL to the FAP.
- 54
- 55 40-43. The FAP sends a SIP 487 (Request Terminated) response to the MGCF/MGW. The SIP
- 56 487 (Request Terminated) response is a response to the SIP INVITE request.
- 57
- 58 44-47. The FAP answers the SIP CANCEL request by sending a SIP 200 (OK) response to the
- 59 MGCF/MGW.
48. The Originating MSC establishes a call to the specified forward-to number.

5.3.2.2 CFID Invocation with No Response to Page

The following flow illustrates CFID invocation when the MS does not respond to the page request, for a 1x MS attached to a FAP (see Figure 4 of [X.S0004-322]).

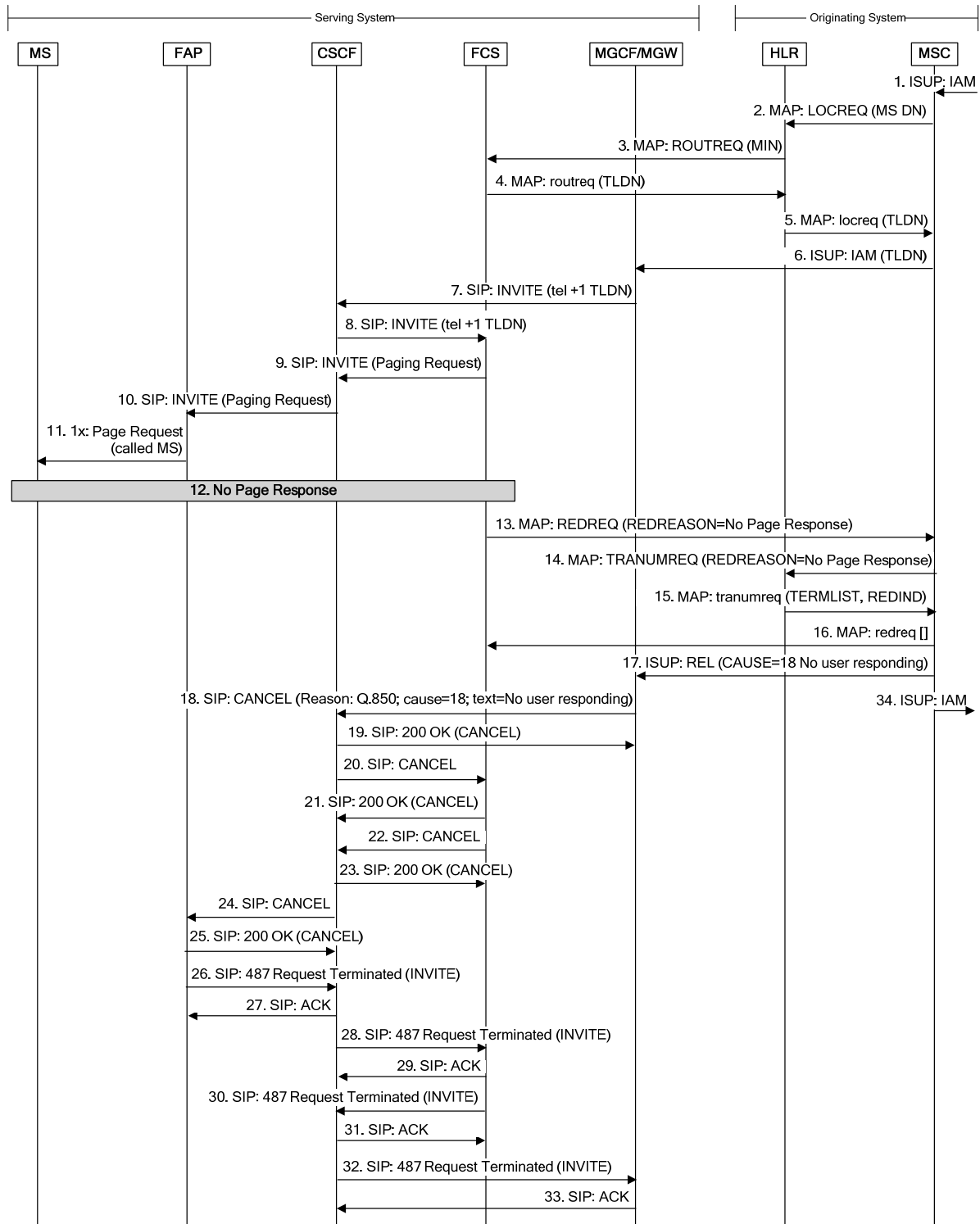


Figure 6 Call Forwarding-Default (CFD) Invocation with No Response to Page

1. The Originating MSC receives a call origination.
2. The Originating MSC sends a LocationRequest INVOKE to the HLR.
3. The HLR sends a Routing Request INVOKE to the FCS at which the subscriber is registered.
- 4-5. The FCS allocates a TLDN which is in the range of the public service IDs (PSI) assigned to this FCS. The FCS stores the temporary association between the called party and the TLDN. The FCS returns the TLDN to the Originating MSC.
6. The incoming call is routed to the MGCF/MGW via the TLDN.
7. The MGCF converts the incoming call to a SIP INVITE request and sends it to the CSCF for delivery to the FCS.
8. The FCS retrieves the called party information associated with the TLDN and replaces the Request-URI with the FAP currently serving that user and populates the To header with the mobile directory number in tel URI format [RFC 3966].
- 9-10. The FCS sends the SIP INVITE request to the S-CSCF which routes the SIP INVITE request to the FAP, and starts a timer T_{3113} .
11. The FAP pages the MS identified in the To header.
12. The MS does not respond to the page (e.g., it has moved away from the FAP).
13. Upon expiration of timer T_{3113} , the FCS sends a RedirectionRequest INVOKE to the Originating MSC, indicating that the call is being redirected due to a “no page response” condition.
14. The Originating MSC is able to redirect the call, therefore, it sends a TransferToNumberRequest INVOKE to the HLR requesting the forward-to number appropriate for this condition from the MS’s service profile.
15. The HLR sends the TransferToNumberRequest RETURN RESULT to the Originating MSC, including the appropriate forward-to number in the TerminationList parameter, along with an indication of the reason for extending the incoming call (i.e., for CFD) in the DMH_RedirectionIndicator parameter.
16. When the TransferToNumberRequest RETURN RESULT is received from the HLR, the Originating MSC sends a RedirectionRequest RETURN RESULT to the FCS.
17. The Originating MSC releases the voice path and sends an ISUP Release message, with “Cause=18 No user responding”, to the MGCF.
- 18-25. The MGCF/MGW maps the ISUP Release to a SIP CANCEL request [TS 29.163]. The Reason header is set to “Reason: Q.850; cause=18; text=No user responding” [TS 29.163] [RFC 3326]. The MGCF/MGW sends the SIP CANCEL to the CSCF, which responds with SIP 200 (OK) response. Each hop then forwards the SIP CANCEL after responding with SIP 200 (OK) response, until the SIP CANCEL is delivered to the FAP.
- 26-33. The FAP sends a SIP 487 (Request Terminated) response to the MGCF/MGW. The SIP 487 (Request Terminated) response is a response to the SIP INVITE request. Each hop generates a SIP ACK request to the SIP 487 (Request Terminated) response (as specified in [RFC 3261]).
34. Anytime after receiving the TransferToNumberRequest RETURN RESULT (Step 15), the Originating MSC establishes a call to the specified forward-to number.

5.3.3 Call Forwarding–No Answer (CFNA)

This scenario applies to the invocation of CFNA due to the following causes:

- No MS response to a page request (see Section 5.3.2.2);
- No MS or subscriber response to alerting (see Section 5.3.2.1);
- No subscriber response to Call Waiting notification (see Section 5.5.3.2).

5.3.4 Call Forwarding–Unconditional (CFU)

CFU is implemented in the HLR. The optional CFU alert to the served MS is not implemented (see Figure 5 of [X.S0004-322]).

5.4 Communication Barring

5.4.1 Incoming Call Barring (ICB) / Anonymous Call Rejection (ACR)

ICB and ACR are implemented in the HLR.

5.4.2 Outgoing Call Barring (OCB)

The following informational flow illustrates the application of Call Barring to a call originated from a 1x MS via a FAP.

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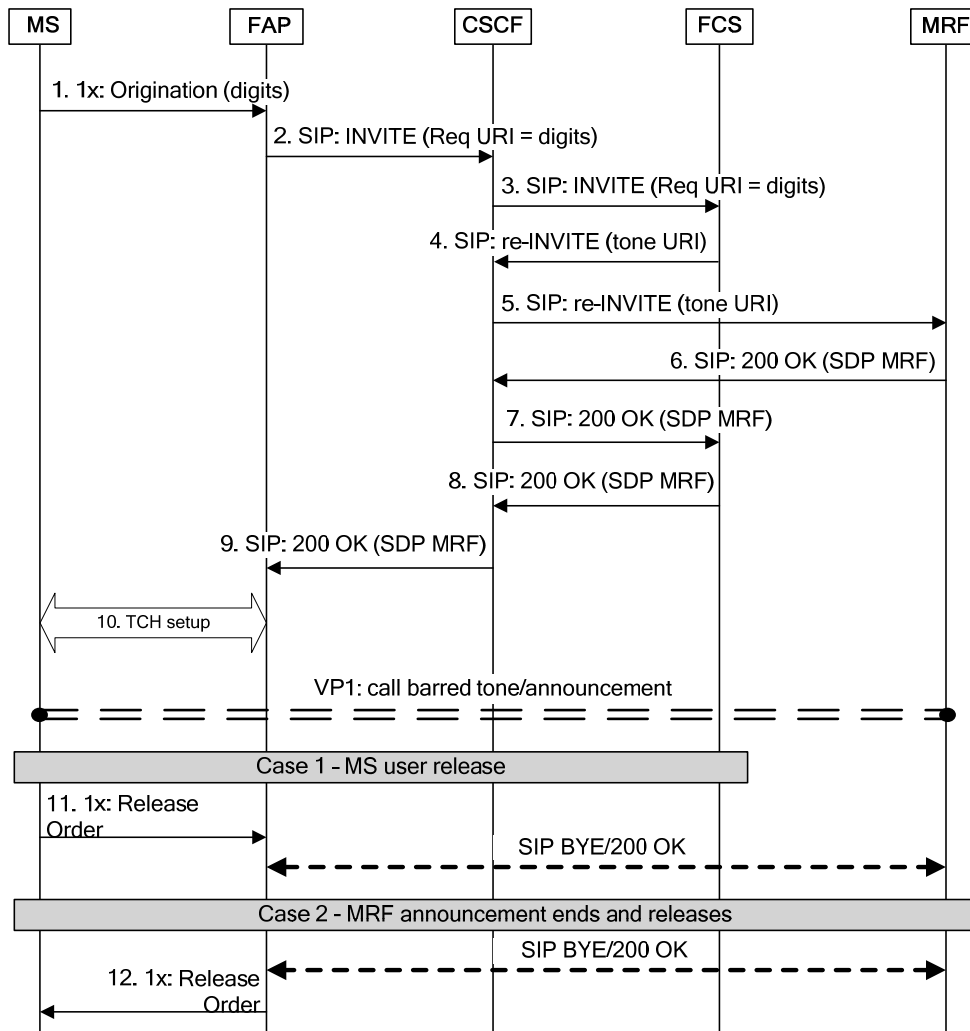


Figure 7 Outgoing Call Barring (OCB)

Preconditions: The FAP has previously connected to the network, set up the IPsec tunnel and is IMS registered. The MS has previously registered and the FCS has a VLR entry for this subscriber.

1. The call origination, with dialed digits, is signaled over the air to the FAP.
2. The FAP maps the call origination message into a SIP INVITE request. The SIP INVITE request is routed to the P-CSCF and then the S-CSCF. The SIP INVITE request contains an SDP offer generated by the FAP.
3. The S-CSCF sends the SIP INVITE request to the FCS per the initial filter criteria.
4. The FCS performs call barring analysis based on the calling subscriber's VLR record and replaces the Request-URI of the SIP INVITE request with a URI that will result in the playing of a particular call barred tone/announcement by a Media Server [RFC 4240]. This SIP re-INVITE request is forwarded to the S-CSCF.
5. The S-CSCF forwards the SIP re-INVITE request to the MRF.

- 6-9. The MRF responds to the SIP INVITE request with a SIP 200 (OK) response that contains an SDP offer to connect the bearer path to the MRF for the playing of the call barred tone/announcement.
10. The FAP establishes a traffic channel with the MS based on the information received in the 1x Origination message from the MS and the capabilities/bandwidth availability at the FAP.
- 11-12. The call is released either by the MS or the MRF when the call barred tone/announcement timer expires. Note that after Step 9, a SIP ACK request is sent back along the route to the MRF in response to the SIP 200 (OK) response.

Note: Steps 11 and 12 represent two separate release cases. At Step 11, the MS releases the call. At Step 12, the call barring announcement completes and the MRF releases the session.

5.5 Mid-Call Services

5.5.1 Call Hold (HOLD)

5.5.1.1 HOLD Invocation – OEP-initiated

The following informational flow illustrates OEP-initiated HOLD invocation.

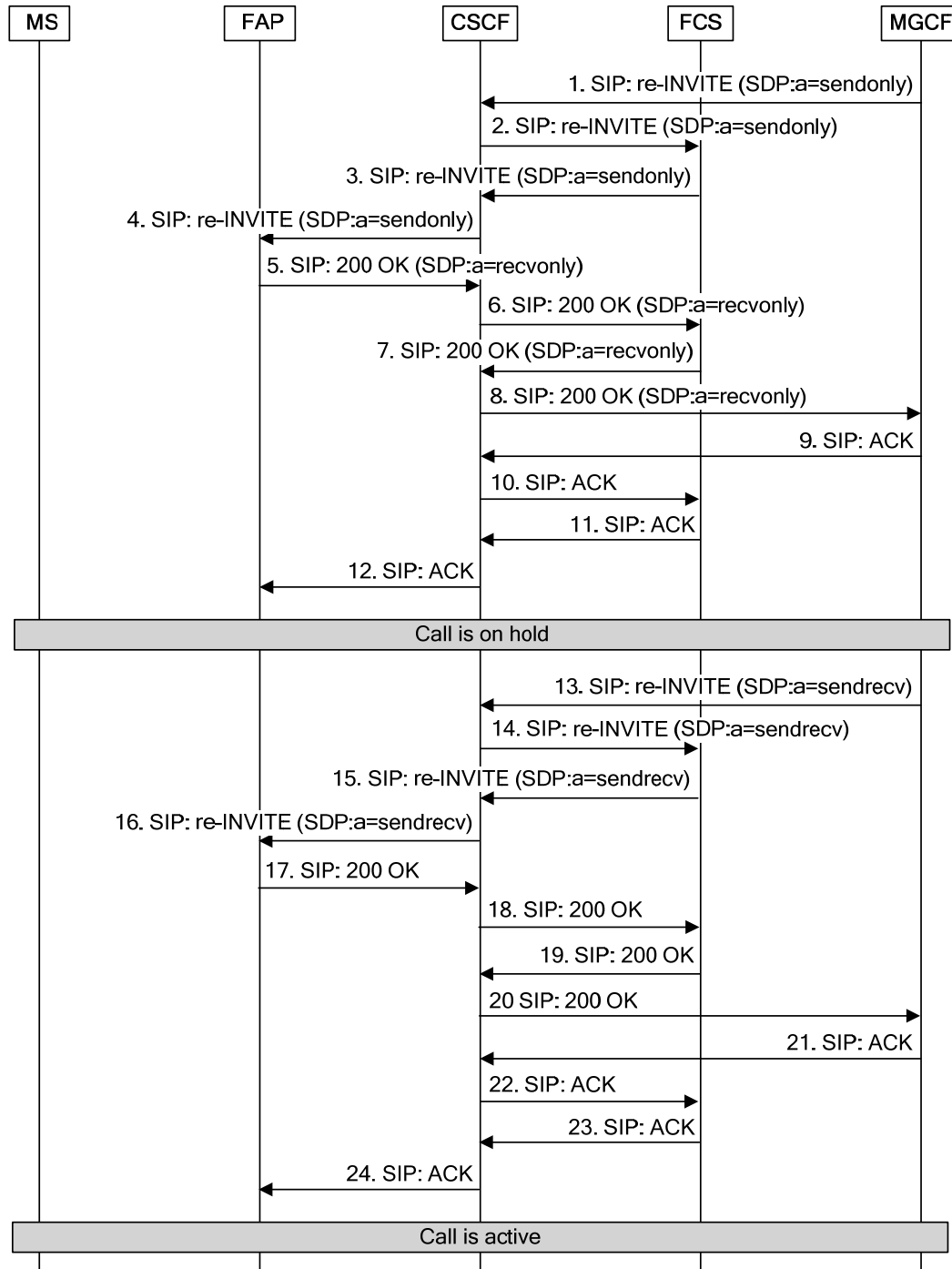


Figure 8 Call Hold (HOLD) – OEP-initiated

Preconditions: The FAP has previously connected to the network, set up the IPsec tunnel and is IMS registered. The MS has previously registered and is on an active call.

- 1-2. The MGCF sends a SIP re-INVITE request with SDP set to “sendonly” (as the result of the other party generating a flash request to place the call on hold) to the FCS.
- 3-4. The FCS then sends the SIP re-INVITE request to the FAP.

- 5-6. The FAP responds to the FCS with SIP 200 OK with SDP set to “recvonly”. 1
- 7-8. The FCS then sends the SIP 200 OK with SDP set to “recvonly” to the MGCF. 2
- 9-10. The MGCF responds to the FCS with SIP ACK request. 3
- 11-12. The FCS then sends SIP ACK request to the FAP. 4
- Note: The call is now on hold. 5
- 13-14. The MGCF sends a SIP re-INVITE request with SDP set to “sendrecv” (as the result of the other party generating a flash request to resume the call) to the FCS. 6
- 15-16. The FCS then sends the SIP re-INVITE request with SDP set to “sendrecv” to the FAP. 7
- 17-18. The FAP responds to the FCS with SIP 200 OK. 8
- 19-20. The FCS then sends SIP 200 OK to the MGCF. 9
- 21-22. The MGCF responds to the FCS with SIP ACK request. 10
- 23-24. The FCS then sends SIP ACK request to the FAP. 11
- Note: The call is now active. 12

5.5.2 Call Transfer (CT)

Call Transfer is not implemented. 13

5.5.3 Call Waiting (CW)

5.5.3.1 CW Invocation – Mobile User Accepts Incoming Call

The following informational flow illustrates Call Waiting invocation for a 1x MS that is registered with a FAP, has CW activated, and is on a call with User 1 when a call is received from User 2. In this scenario, the MS user accepts the call from User 2, which places User 1 on hold. 14

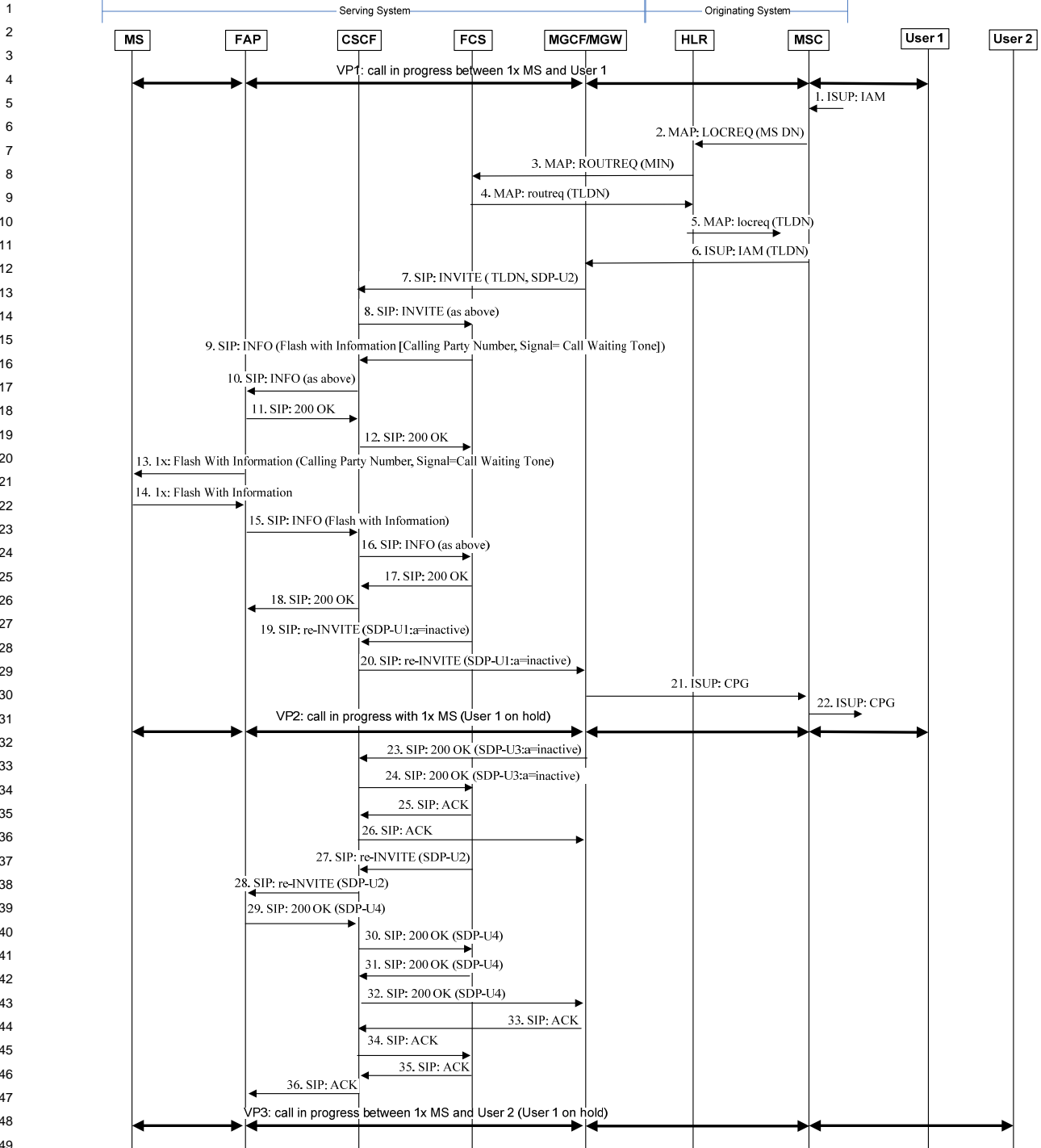


Figure 9 CW Invocation – Mobile User Accepts Incoming Call

Preconditions: The FAP has previously connected to the network, set up the IPsec tunnel and is IMS registered. The 1x MS has previously registered, CW is activated, and the 1x user is busy in a call with User 1. User 2 dials the 1x user’s mobile directory number, which is routed to the 1x user’s home (originating) MSC.

1. The Originating MSC receives a call origination (from User 2).

2. The Originating MSC sends a LOCREQ to the HLR associated with the Called Party Number in the ISUP IAM. 1
3. If the dialed digits are assigned to a valid subscriber, the HLR sends a ROUTREQ to the FCS where the MS is presently registered. 2
- 4-5. The FCS allocates a TLDN associated with one of the public service IDs (PSI) assigned to this FCS. The FCS stores the temporary association between the Called Party Number and the TLDN. The FCS returns the TLDN in the routreq to the HLR. The HLR returns the TLDN in the locreq to the Originating MSC. 3
6. The incoming call request is routed to the MGCF/MGW via the TLDN. 4
- 7-8. The MGCF/MGW converts the incoming call request to a SIP INVITE request. The SIP INVITE request contains an SDP offer (SDP-U2) and is sent to the FCS. 5
- 9-10. The FCS retrieves the called party information associated with the TLDN. Noting that the called MS is busy and CW is activated, the FCS sends a SIP INFO request to the FAP indicating a second call from User 2. The SIP INFO request contains a Flash with Information message (A.S0014). The MS Informational Records IE (A.S0014) within the Flash with Information message contains Signal with a value of "Call Waiting Tone on" and the Calling Party Number. The FCS sends the SIP INFO to the FAP. 6
- The FCS starts timers T_{cw-1} and T_{cw-2} . When timer T_{cw-1} expires the FCS re-sends the SIP INFO request containing the Flash with Information message and restarts timer T_{cw-1} . When timer T_{cw-2} expires the FCS send a SIP INFO request containing a Flash with Information message with the MS Informational Records IE containing Signal with a value of "Confirm tone". The "Confirm tone" informs the MS user that the second call, from User 2, may no longer be accepted. Based upon the subscriber profile, the FCS performs termination treatment on the second call (e.g., forwards the call to voice mail) or releases the second call. 7
- 11-12. The FAP responds to the SIP INFO request by sending a SIP 200 OK to the FCS. 8
13. The FAP sends a Flash With Information message (C.S0005) to the MS. 9
14. The MS user accepts the second call. The MS sends a Flash with Information message (C.S0005) to the FAP to indicate the acceptance of the second call. 10
- 15-16. The FAP sends a SIP INFO request, containing a Flash with Information message (A.S0014), to the FCS indicating the acceptance of the second call. 11
- 17-18. In response to the SIP INFO request, the FCS sends a SIP 200 OK to the FAP. The FCS stops timers T_{cw-1} and T_{cw-2} . 12
- 19-20. The FCS places User 1 on hold. The FCS sends a SIP re-INVITE request to the MGCF/MGW with an SDP offer (SDP-U1 with "a" set to "inactive"). 13
21. The MGCF/MGW sends the MSC a CPG indicating a 'remote hold'. 14
22. The MSC sends the next ISUP hop, towards User 1, a CPG indicating a 'remote hold'. 15
- 23-24. In response to the SIP re-INVITE request (step 20), the MGCF/MGW sends a SIP 200 OK with an SDP answer (SDP-U3 with a=inactive). 16
- 25-26. The FCS, in response to Step 24, sends a SIP ACK request to the MGCF/MGW. 17
- 27-28. The FCS bridges the 1x MS with User 2 by sending a SIP re-INVITE request containing an SDP offer to the FAP. The SDP offer is SDP-U2 received in Step 8. 18

- 1 29-30. In response to the SIP re-INVITE request (step 28), the FAP sends a SIP 200 OK
2 containing an SDP answer (SDP-U4) to the FCS.
3
4 31-32. In response to the SIP INVITE request (step 8), the FCS sends a SIP 200 OK containing
5 (SDP-U4) to the MGCF/MGW.
6
7 33-34. The MGCF/MGW responds to the SIP 200 OK (step 32) with a SIP ACK request and
8 sends it to the FCS.
9
10 35-36. The FCS sends a SIP ACK request to the FAP. The SIP ACK request is in response to
11 Step 29.
12

13 **5.5.3.2 CW Invocation – Mobile User Rejects Incoming Call**

14
15 The following informational flow illustrates Call Waiting invocation for a 1x MS that is
16 registered with a FAP, has CW activated, and is on a call with User 1 when a call is received
17 from User 2. In this scenario, the MS user rejects the call from User 2 by ignoring the call
18 waiting tone.
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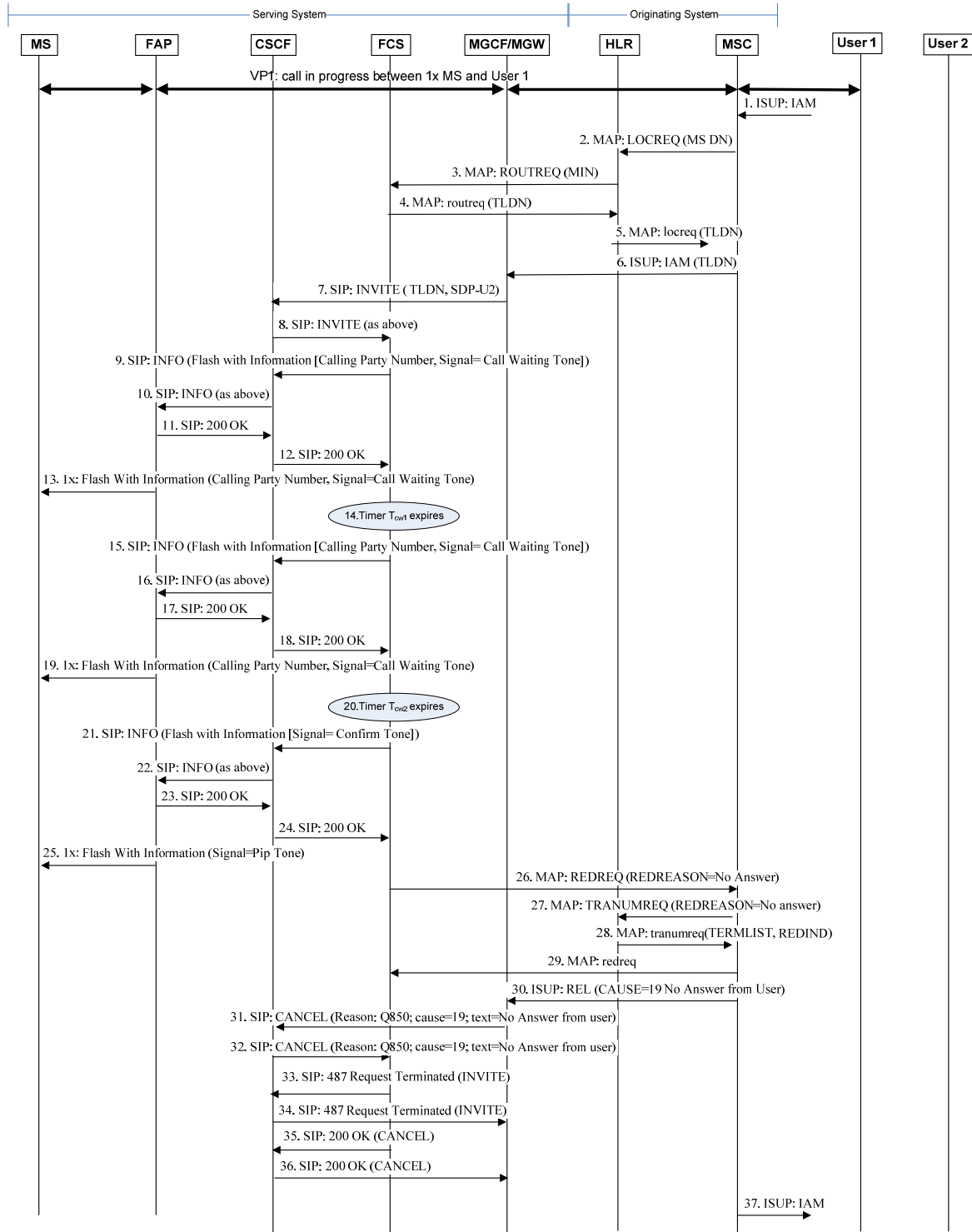


Figure 10 CW Invocation – Mobile User Rejects Incoming Call

Preconditions: The FAP has previously connected to the network, set up the IPsec tunnel and is IMS registered. The 1x MS has previously registered, CW is activated, and the 1x user is busy in a call with User 1. User 2 dials the 1x user’s mobile directory number, which is routed to the 1x user’s home (originating) MSC.

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1. The Originating MSC receives a call origination (from User 2).
2. The Originating MSC sends a LOCREQ to the HLR associated with the Called Party Number in the ISUP IAM.
3. If the dialed digits are assigned to a valid subscriber, the HLR sends a ROUTREQ to the FCS where the MS is presently registered.
- 4-5. The FCS allocates a TLDN associated with one of the public service IDs (PSI) assigned to this FCS. The FCS stores the temporary association between the Called Party Number and the TLDN. The FCS returns the TLDN in the routreq to the HLR. The HLR returns the TLDN in the locreq to the Originating MSC.
6. The incoming call request is routed to the MGCF/MGW via the TLDN.
- 7-8. The MGCF/MGW converts the incoming call request to a SIP INVITE request. The SIP INVITE request contains an SDP offer (SDP-U2) and is sent to the FCS.
- 9-10. The FCS retrieves the called party information associated with the TLDN. Noting that the called MS is busy and CW is activated, the FCS sends a SIP INFO request to the FAP indicating a second call from User 2. The SIP INFO request contains a Flash with Information message (A.S0014). The MS Informational Records IE (A.S0014) within the Flash with Information message contains Signal with a value of "Call Waiting Tone on" and the Calling Party Number. The FCS sends the SIP INFO to the FAP.
The FCS starts timers T_{cw-1} and T_{cw-2} .
- 11-12. The FAP responds to the SIP INFO request by sending a SIP 200 OK to the FCS.
13. The FAP sends a Flash With Information message (C.S0005) to the MS.
14. Timer T_{cw-1} expires.
- 15-16. The FCS resends the SIP INFO request to the FAP indicating a second call from User 2. The SIP INFO request contains a Flash with Information message (A.S0014). The MS Informational Records IE (A.S0014) within the Flash with Information message contains Signal with a value of "Call Waiting Tone on" and the Calling Party Number. The FCS sends the SIP INFO to the FAP.
The FCS restarts timer T_{cw-1} .
- 17-18. The FAP responds to the SIP INFO request by sending a SIP 200 OK to the FCS.
19. The FAP sends a Flash With Information message (C.S0005) to the MS.
20. Timer T_{cw-2} expires.
- 21-22. Upon timer T_{cw-2} expiring, the FCS resends a SIP INFO request to the FAP contains a Flash with Information message (A.S0014). The MS Informational Records IE (A.S0014) within the Flash with Information message contains Signal with a value of "Confirm Tone". The "Confirm tone" is a verbally indication to the MS user that the second call, from User 2, may no longer be accepted.
- 23-24. The FAP responds to the SIP INFO request by sending a SIP 200 OK to the FCS.
25. The FAP sends a Flash With Information message (C.S0005) to the MS.
26. The FCS then sends a REDREQ to the Originating MSC, indicating that the call is being redirected due to a "No Answer" condition.

27. The Originating MSC is able to redirect the call, therefore, it sends a TRANUMREQ to the HLR requesting the forward-to number appropriate for this condition from the MS's service profile. 1
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28. The HLR sends the tranumreq to the Originating MSC, including the appropriate forward-to number in the TerminationList parameter, along with an indication of the reason for extending the incoming call (i.e., for CFB) in the DMH_RedirectionIndicator parameter. 5
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29. When the tranumreq is received from the HLR, the Originating MSC sends a redreq to the FCS. 10
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30. The Originating MSC releases the voice path and sends an ISUP Release message, with "Cause=19 No Answer", to the MGCF/MGW. 13
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- 31-32. The MGCF/MGW maps the ISUP Release to a SIP CANCEL [TS 29.163]. The Reason header is set to "Reason: Q.850; cause=19; text=No Answer" [TS 29.163] [RFC 3326]. The MGCF/MGW sends the CANCEL to the FCS. 16
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- 33-34. The FCS sends a SIP 487 (Request Terminated) response to the MGCF/MGW. The SIP 487 (Request Terminated) response is a response to the SIP INVITE request. 19
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- 35-36. The FCS answers the CANCEL request by sending a SIP 200 OK message to the MGCF/MGW. 22
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37. The Originating MSC establishes a call to the specified forward-to number. 25
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5.5.4 Three-Way Calling (3WC) 28

5.5.4.1 3WC Invocation – Establishment 29

The following informational flow illustrates Three-Way Calling invocation for a 1x MS that is registered with a FAP, has 3WC activated, and has initiated a call with User 1. In this scenario the MS user places User 1 on hold, then dials and is connected with User 2 (User 1 remains on hold). 30
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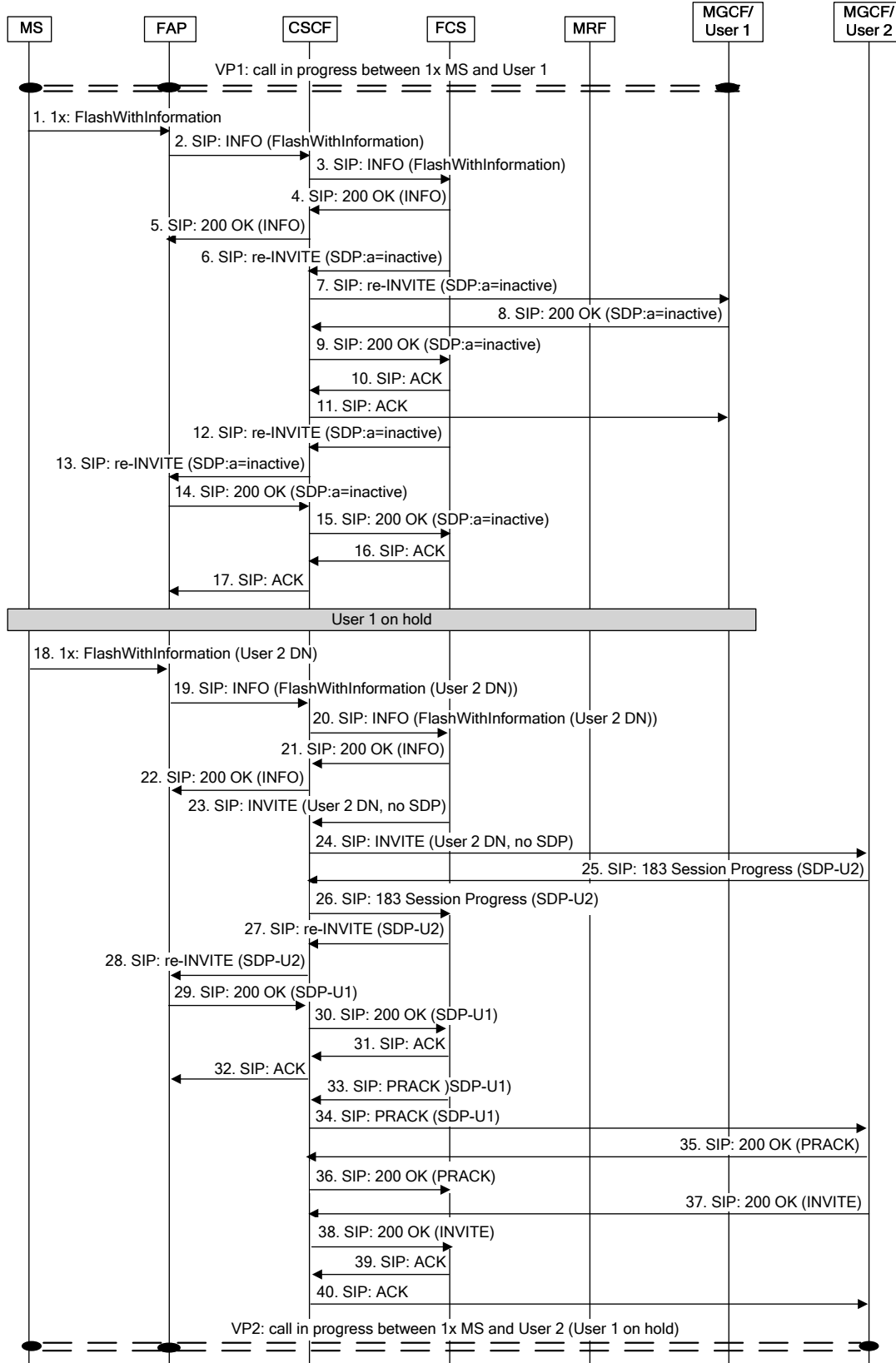


Figure 11 3WC Invocation – Establishment

Preconditions: The FAP has previously connected to the network, set up the IPsec tunnel and is IMS registered. The 1x MS has previously registered, 3WC is activated, and the 1x user has initiated a call with User 1.

1. The MS user generates a flash request in order to place the active call on hold, and the MS sends a 1x FlashWithInformation message to the FAP.
 - 2-3. The FAP sends a SIP INFO request with an encapsulated A1 FlashWithInformation message to the FCS.
 - 4-5. The FCS responds to the FAP with a SIP 200 (OK) response.
 - 6-7. Since the MS is in an active call, the FCS sends a SIP re-INVITE request with the attribute for the media set to a=inactive in the SDP to the MGCF serving the call.
 - 8-9. The MGCF responds to the FCS with a SIP 200 (OK) response (including the media attribute set to "a=inactive" for the media in the SDP).
 - 10-11. The FCS responds to the MGCF with a SIP ACK request.
 - 12-13. The FCS then sends a SIP re-INVITE request including the media attribute set to "a=inactive" for the media in the SDP to the FAP.
 - 14-15. The FAP responds to the FCS with a SIP 200 (OK) response (including the media attribute set to "a=inactive" for the media in the SDP).
 - 16-17. The FCS responds to the FAP with a SIP ACK request.
- Note: The call with User 1 is now on hold.
18. The MS user enters the directory number for User 2 and generates a flash request, and the MS sends a 1x FlashWithInformation message with the entered digits to the FAP.
 - 19-20. The FAP sends a SIP INFO request with an encapsulated A1 FlashWithInformation message containing the entered digits to the FCS.
 - 21-22. The FCS responds to the FAP with a SIP 200 (OK) response.
 - 23-24. If the MS has provided dialed digits (in steps 19-20), the FCS sends a SIP INVITE request with the dialed digits and no SDP to the MGCF.
 - 25-26. The MGCF responds to the FCS with a SIP 183 (Session Progress) response containing an SDP offer (SDP-U2) for this session.
 - 27-28. The FCS then sends a SIP re-INVITE request containing SDP-U2 to the FAP.
 - 29-30. The FAP responds to the FCS with a SIP 200 (OK) response containing the SDP for the existing session with User 1 (SDP-U1).
 - 31-40. The session between the MS and User 2 is established.

5.5.4.2 3WC Invocation – Connection

The following informational flow illustrates connection via a media server of the three parties involved in a three-way call that has been initiated by a 1x MS that is registered with a FAP. In this scenario the MS user has placed an active call with User 1 on hold and established a connection with User 2, and is now bridging the parties together.

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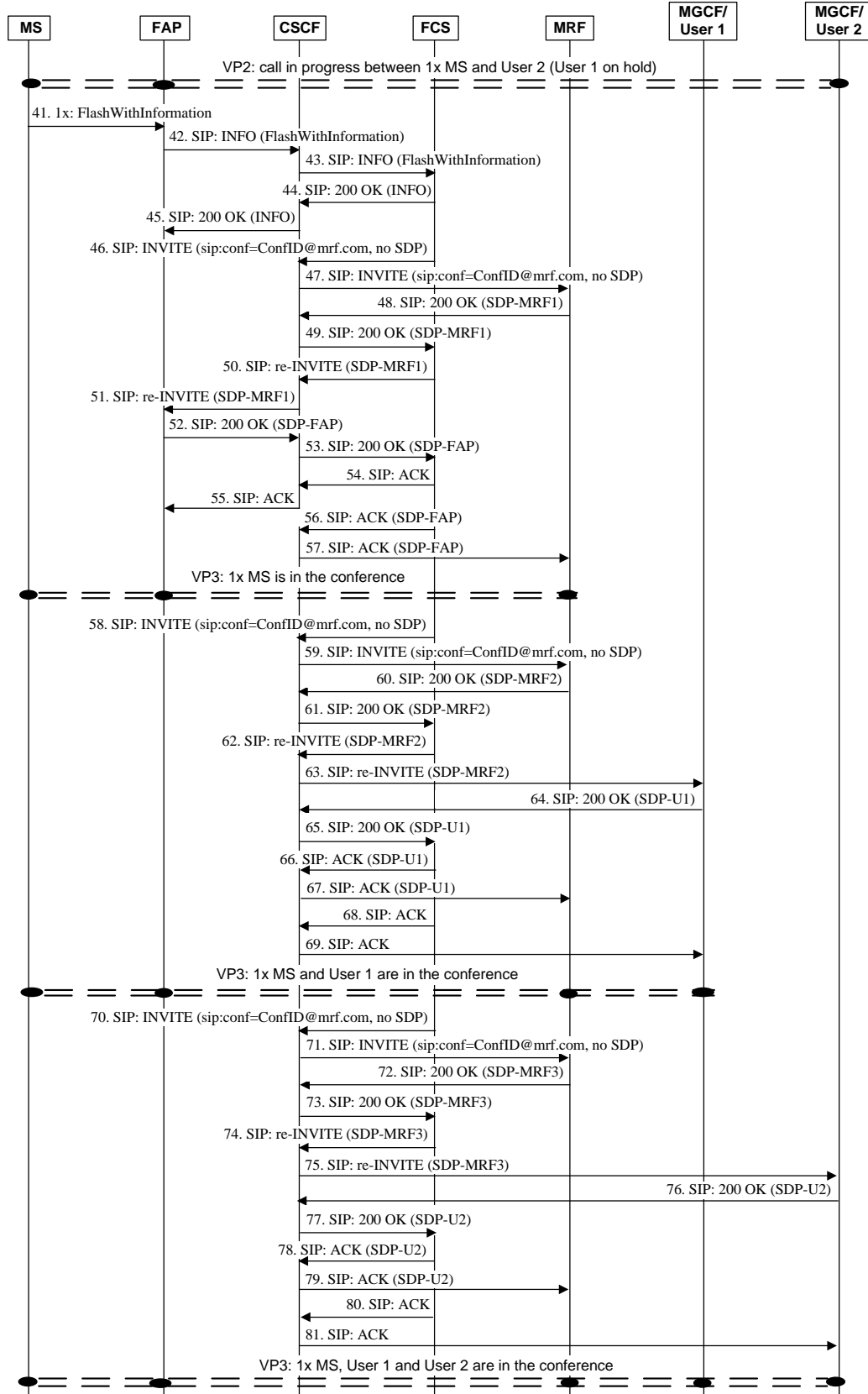


Figure 12 3WC Invocation – Connection

Preconditions: The FAP has previously connected to the network, set up the IPsec tunnel and is IMS registered. The 1x MS has previously registered, 3WC is activated, and the 1x user is busy in a call with User 2 while User 1 is on hold.

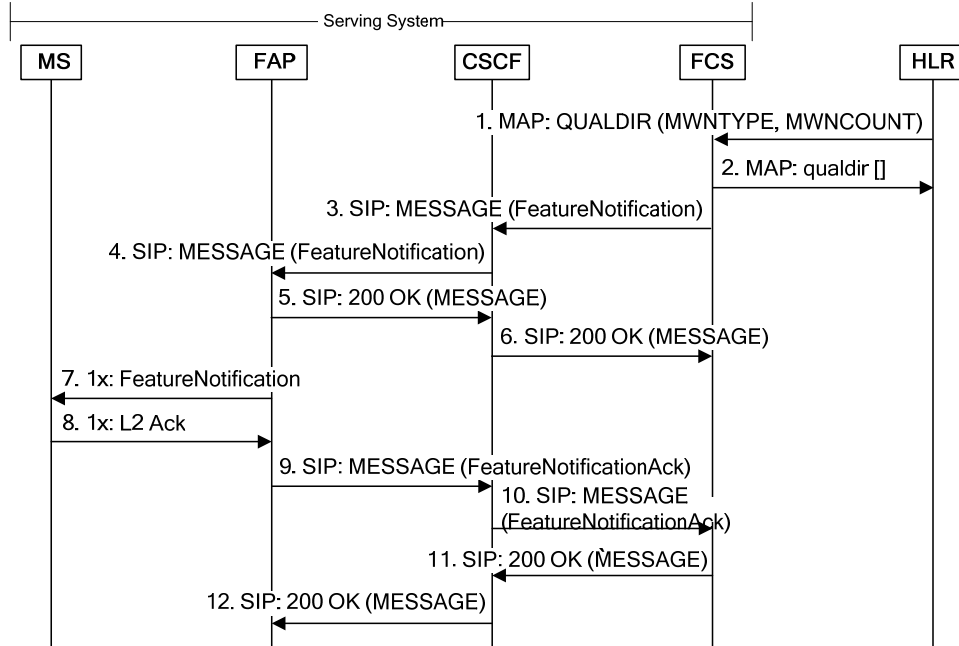
41. The MS user generates a flash request in order to connect the parties, and the MS sends a 1x FlashWithInformation message to the FAP.
- 42-43. The FAP sends a SIP INFO request with an encapsulated A1 FlashWithInformation message to the FCS.
- 44-45. The FCS responds to the FAP with SIP 200 OK.
- 46-47. The FCS begins the process of bridging the parties by sending a SIP INVITE request to the media server (MRF) with a unique "ConfID" encoded in the SIP URI and no SDP.
- 48-49. The MRF responds to the FCS with SIP 200 OK containing an SDP offer for the session.
- 50-51. The FCS then sends a SIP re-INVITE request to the FAP with the SDP offer from the MRF.
- 52-57. Standard SIP signaling is followed to place the 1x MS into the conference.
- 58-69. The FCS repeats the process (steps 46-57) with User 1 to join User 1 into the conference.
- 70-81. The FCS repeats the process (steps 46-57) with User 2 to join User 2 into the conference.

5.6 Other Services

5.6.1 Message Waiting Notification (MWN)

5.6.1.1 MWN via an MS Indication – MS Idle

The following informational flow illustrates Message Waiting Notification for an idle 1x MS that is registered with a FAP (see Figure 3 of [X.S0004-329]).



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Figure 13 MWN Invocation – MS Idle

Preconditions: The FAP has previously connected to the network, set up the IPsec tunnel and is IMS registered. The 1x MS has previously registered, MWN is activated, and the 1x MS is idle. The HLR is notified that there is a message waiting for the served MS.

1. The HLR reports the change in the MWN status of the served MS by sending a QualificationDirective INVOKE to the FCS.
2. The FCS sends a qualificationdirective RETURN RESULT to the HLR.
- 3-4. Upon determining that the MS is idle, the FCS sends a SIP MESSAGE request containing an encapsulated IOS Feature Notification message.
- 5-6. The FAP responds to the SIP MESSAGE request with SIP 200 OK.
7. The FAP sends a 1x Feature Notification message to the MS.
8. The MS responds with Layer 2 Ack.
- 9-10. The FAP sends a SIP MESSAGE request containing an encapsulated IOS Feature Notification Ack message to the FCS.
- 11-12. The FCS responds to the SIP MESSAGE request with SIP 200 OK.

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5.6.1.2 MWN via an MS Indication – MS on an Active Call

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The following informational flow illustrates Message Waiting Notification for a 1x MS that is registered with a FAP and is on an active call (see Figure 3 of [X.S0004-329]).

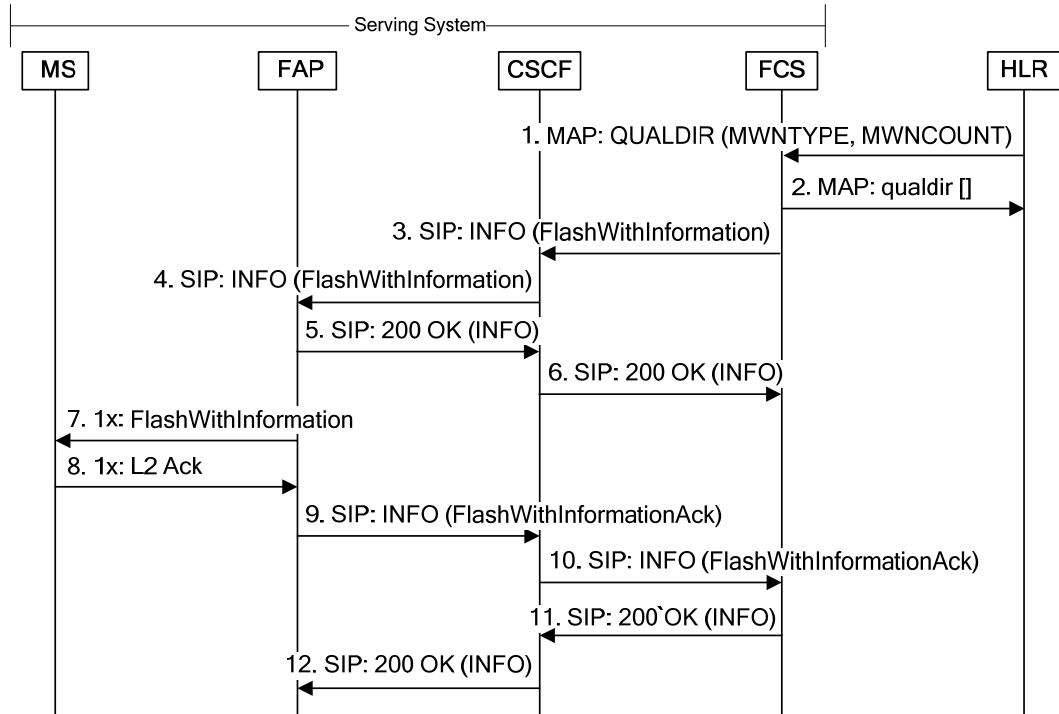


Figure 14 MWN Invocation – MS on an Active Call

Preconditions: The FAP has previously connected to the network, set up the IPsec tunnel and is IMS registered. The 1x MS has previously registered, MWN is activated, and the 1x MS is engaged in an active call. The HLR is notified that there is a message waiting for the served MS.

1. The HLR reports the change in the MWN status of the served MS by sending a QualificationDirective INVOKE to the FCS.
2. The FCS sends a qualificationdirective RETURN RESULT to the HLR.
- 3-4. Upon determining that the MS has an active call, the FCS sends a SIP INFO request containing an encapsulated IOS Flash With Information message.
- 5-6. The FAP responds to the SIP INFO request with SIP 200 OK.
7. The FAP sends a 1x Flash With Information message to the MS.
8. The MS responds with Layer 2 Ack.
- 9-10. The FAP sends a SIP INFO request containing an encapsulated IOS Flash With Information Ack message to the FCS.
- 11-12. The FCS responds to the SIP INFO request with SIP 200 OK.

5.6.1.3 MWN After Handoff

Message Waiting Notification for a 1x MS on an active call that begins on a FAP and is handed off to the macro network is shown in Figure 4 of [X.S0004-329] (the FCS serves as the Anchor MSC).

6 Procedures and Protocols

6.1 Overview

This section contains general guidelines on the construction of application content included in SIP messages sent between the FAP and the FCS, as well as specific guidelines on constructing and sending SIP MESSAGE and SIP INFO requests sent between the FAP and the FCS.

6.1.1 Guidelines on use of IOS Messages

See “Guidelines on Use of IOS Messages” in [X.S0059-200].

6.1.2 Guidelines on constructing a SIP MESSAGE request

See “Guidelines on Constructing a SIP MESSAGE Request” in [X.S0059-200].

6.1.3 Guidelines on sending a SIP MESSAGE request

See “Guidelines on Sending a SIP MESSAGE Request” in [X.S0059-200].

6.1.4 Guidelines on constructing a SIP INFO request

The FAP or FCS that supports the SIP INFO method [RFC 2976] shall include the INFO method in the Allow header field of every SIP INVITE request that it generates as described in [X.S0059-200].

All SIP INFO requests sent by the FAP toward the FCS shall be constructed as specified in Section 6.1.4.1.

All SIP INFO requests sent by the FCS toward the FAP shall be constructed as specified in Section 6.1.4.2.

6.1.4.1 Construction of SIP INFO request by FAP (sent toward FCS)

The FAP shall construct a SIP INFO request destined for the FCS based on the information saved for the related dialog, in accordance with the following requirements:

- the Request-URI shall be set to the SIP URI of the FCS;
- the From header field shall be set to the registered Public User Identity of the FAP including the display name set to the MIN of the MS, if applicable;
- the To header field shall be set to the SIP URI of the FCS;
- the Call-ID header field shall be set to the Call-Id header field value stored for the dialog;
- the Route header field shall be set to the routing information stored for the dialog;
- the Via header field shall include the internal IP address or FQDN of the FAP in the sent-by field;

- the Content-Type header shall be set to “application/vnd.3gpp2.FemtoInterfaceMsg”;
- a FemtoInterfaceMsg body constructed as specified in Section 6.1.1 shall be included within the message body.

6.1.4.2 Construction of SIP INFO request by FCS (sent toward FAP)

The FCS shall construct a SIP INFO request destined for the FAP based on the information saved for the related dialog, in accordance with the following requirements:

- the Request-URI shall be set to the registered Public User Identity of the FAP;
- the From header field shall be set to the SIP URI of the FCS;
- the To header shall be set to the registered Public User Identity of the FAP;
- the Call-ID header field shall be set to the Call-ID header field value stored for the dialog;
- the Via header field shall include the internal IP address or FQDN of the FCS in the sent-by field;
- the Content-Type header field shall be set to “application/vnd.3gpp2.FemtoInterfaceMsg”; and
- a FemtoInterfaceMsg body constructed as specified in Section 6.1.1 shall be included within the message body.

6.1.5 Guidelines on sending a SIP INFO request

The FAP shall send a SIP INFO request as specified in Section 6.1.5.1.

The FCS shall send a SIP INFO request as specified in Section 6.1.5.2.

6.1.5.1 Sending a SIP INFO request by FAP (toward FCS)

The FAP shall send the SIP INFO request toward the entry point of the home network through which it completed the IMS registration. See [X.S0059-200] for IMS registration.

6.1.5.2 Sending a SIP INFO request by FCS (toward FAP)

The FCS shall send the SIP INFO request following the procedures specified for an Application Server acting as an originating UA as specified in [TS 24.229].

6.2 Line ID Services

6.2.1 Calling Number Identification Presentation (CNIP)

6.2.1.1 FAP procedures

The FAP shall follow the FAP Procedures for Call Termination as specified in [X.S0059-200], with the following additional requirements when constructing the Alert With Information Message (Alert-With-Info) [C.S0005] sent to the MS:

- 1 ▪ Upon receiving a SIP INVITE request containing a P-Asserted-Identity header, the
- 2 FAP shall use the contents of the received P-Asserted-Identity header to populate a
- 3 Calling Party Number Information Record as described in [C.S0005]. The FAP shall
- 4 include this Calling Party Number Information Record in the Alert With Information
- 5 Message.
- 6
- 7 ▪ Upon receiving a SIP INVITE request that does not contain a P-Asserted-Identity
- 8 header, the FAP shall not include a Calling Party Number Information Record in the
- 9 Alert With Information Message.
- 10

6.2.1.2 FCS procedures

13 The FCS shall follow the FCS Procedures for Call Termination as specified in [X.S0059-

14 200], with the following additional requirements when constructing the SIP INVITE request

15 sent to the FAP:

- 17 ▪ Upon receiving a SIP INVITE request containing a P-Asserted-Identity header field,
- 18 the FCS shall verify that the MS service profile indicates CNIP is active. If CNIP is
- 19 active and the Privacy header (if present) is not set to “id”, the FCS shall not modify
- 20 the content of the P-Asserted-Identity header field when populating the SIP INVITE
- 21 request toward the FAP. If CNIP is not active or the Privacy header is set to “id”,
- 22 the FCS shall not include the P-Asserted-Identity header field and shall set the From
- 23 header field to “anonymous” and shall set the Privacy header field to “id” when
- 24 populating the SIP INVITE request toward the FAP.
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6.2.2 Calling Number Identification Restriction (CNIR)

6.2.2.1 FCS procedures

32 The FCS shall follow the FCS Procedures for Call Origination as specified in [X.S0059-200],

33 with the following additional requirements when constructing the outbound SIP INVITE

34 request:

- 36 ▪ if the CallingFeaturesIndicator parameter of the MS service profile indicates that
- 37 CNIR is active, the FCS shall:
 - 38 — set the display name in the From header field to “anonymous”; and
 - 39 — insert a Privacy header field set to “id”.
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6.3 Communication Diversion Service

6.3.1 Call Forwarding–Busy (CFB)

6.3.1.1 FCS procedures

51 Upon receiving a RoutingRequest INVOKE, the FCS shall follow the procedures for “MSC

52 Receiving RoutingRequest INVOKE” as specified in [X.S0004-640]. If the FCS responds

53 with a RETURN RESULT having the AccessDeniedReason parameter set to *Busy*, then the

54 FCS shall terminate this procedure.

56 Upon receiving a SIP INVITE request from the MGCF that contains the TLDN assigned by

57 the FCS during processing of the RoutingRequest INVOKE, the FCS shall verify that the MS

58 identified by the MDN of the called party number associated with the TLDN is not *busy*. If

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the MS is not *busy*, the FCS shall perform the Call Termination FCS Procedures as specified in [X.S0059-200].

If the MS is *busy* and the MS service profile indicates that CFB is active, the FCS shall:

- perform the procedures for “MSC Initiating a Redirection Request” (with the RedirectionReason parameter set to *Busy*) as specified in [X.S0004-640];
- upon receiving a SIP CANCEL request from the MGCF in the same dialog as the SIP INVITE request:
 - send a SIP 487 (Request Terminated) response in response to the initial SIP INVITE request; and
 - send a SIP 200 (OK) response in response to the SIP CANCEL request;

otherwise (if the MS is *busy* and CFB is not active), the FCS shall send SIP 480 (User Unavailable) response in response to the initial SIP INVITE request.

6.3.2 Call Forwarding–Default (CFD)

6.3.2.1 FCS procedures

The FCS shall perform the FCS Procedures for Call Termination as specified in [X.S0059-200].

If the MS service profile indicates that CFNA is active, the FCS shall perform the following additional procedures after sending a SIP INVITE request toward the FAP:

- upon sending the SIP INVITE request toward the FAP, the FCS shall start timer T_{3113} [A.S0014];
- upon receiving a SIP (18x) response from the FAP, the FCS shall stop timer T_{3113} and shall continue to perform the FCS Procedures for Call Termination specified in [X.S0059-200];
- upon receiving a SIP non-(18x) response from the FAP or expiration of timer T_{3113} , the FCS shall:
 - perform the procedures for “MSC Initiating a Redirection Request” (with the RedirectionReason parameter set to *No Page Response*) as specified in [X.S0004-640];
 - upon receiving a SIP CANCEL request in the same dialog as the SIP INVITE request:
 - send a SIP 200 (OK) response to the MGCF in response to the SIP CANCEL request; and
 - send a SIP CANCEL request to the FAP within the same dialog;
 - upon receiving a SIP 487 (Request Terminated) response from the FAP:
 - send a SIP ACK request to the FAP in response; and
 - send a SIP 487 (Request Terminated) response to the MGCF within the same dialog.

If the MS service profile indicates that CFNA is active, the FCS shall perform the following additional procedures after sending a SIP (18x) response:

- 1 ▪ upon sending a SIP (18x) response toward the MGCF, the FCS shall start timer T₃₀₁
2 [A.S0014];
- 3
- 4 ▪ upon receiving a SIP (2xx) response from the FAP, the FCS shall stop timer T₃₀₁ and
5 shall continue to perform the FCS Procedures for Call Termination specified in
6 [X.S0059-200];
- 7
- 8 ▪ upon receiving a SIP non-(2xx) response from the FAP or expiration of timer T₃₀₁,
9 the FCS shall:
 - 10 — perform the procedures for “MSC Initiating a Redirection Request” (with the
11 RedirectionReason parameter set to *No Answer*) as specified in [X.S0004-640];
 - 12 — upon receiving a SIP CANCEL request in the same dialog as the SIP INVITE
13 request, send a SIP CANCEL request to the FAP;
 - 14 — upon receiving a SIP 487 (Request Terminated) response from the FAP in
15 response to the SIP INVITE request, send a SIP 487 (Request Terminated)
16 response to the MGCF;
 - 17 — upon receiving a SIP 200 (OK) response from the FAP in response to the SIP
18 CANCEL request, send a SIP 200 (OK) response to the MGCF.
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25 **6.4 Communication Barring**

26 **6.4.1 Outgoing Call Barring (OCB)**

27 **6.4.1.1 FCS procedures**

28 Upon receiving an initial SIP INVITE request from the FAP, the FCS shall verify the SIP
29 INVITE request is formatted as specified in the Call Origination FAP Procedures in
30 [X.S0059-200].

31 If the received SIP INVITE request is formatted as specified and if the OriginationIndicator
32 parameter of the MS service profile is set to “Origination denied”, the FCS shall send a SIP
33 403 (Forbidden) request in response to the SIP INVITE request. If the received SIP INVITE
34 request is not formatted as specified, the FCS shall send a SIP 400 (Bad Request) response to
35 the FAP and shall terminate the origination procedure.

36 If the FCS responds with a SIP 403 (Forbidden) request, the FCS may apply call treatment
37 back to the originator (e.g., rejection announcement).

38 **6.5 Mid-Call Services**

39 **6.5.1 Call Hold (HOLD)**

40 **6.5.1.1 FAP procedures**

41 Upon receiving a SIP re-INVITE request with an SDP offer that contains “a=sendonly” for a
42 media stream or “a=inactive” for a media stream, the FAP shall send a SIP 200 (OK) response
43 with an SDP answer that contains “a=recvonly” (if the SDP offer for the media stream was set
44 to “a=sendonly”) or “a=inactive” (if the SDP offer for the media stream was set to
45 “a=inactive”). The FAP shall set the associated media stream to the mode sent in the SDP
46 answer.

Upon receiving a SIP re-INVITE request with an SDP offer that contains “a=sendrecv” for a media stream, the FAP shall send a SIP 200 (OK) response with an SDP answer that contains “a=sendrecv” for the media stream in the SDP offer that was set to “a=sendrecv”. The FAP shall set the associated media stream to the mode in the SDP answer.

6.5.1.2 FCS procedures

The FCS behaves as a B2BUA during mobile-originated and mobile-terminated calls as specified in [X.S0059-200].

6.5.2 Call Waiting (CW)

6.5.2.1 FAP procedures

Upon receiving a SIP INFO request with Flash with Information Message Type in the FemtoInterfaceMsg body from the FCS, the FAP shall verify the SIP INFO request is formatted as specified in Section 6.5.2.2.1:

- if the received SIP INFO request is formatted as specified, the FAP shall:
 - send a SIP 200 (OK) response to the FCS;
 - construct a 1x Flash With Information message as specified in [C.S0005], including the information records from the MS Information Records IEs in the encapsulated A1 Flash with Information message; and
 - send the 1x Flash With Information message to the MS identified in the To header of the SIP INFO request;
- otherwise (the received SIP INFO request is not formatted as specified), the FAP shall send a SIP 400 (Bad Request) response to the FCS.

Upon receiving a 1x Flash With Information message from the MS, the FAP shall construct a SIP INFO request that encapsulates an A1 Flash with Information message as specified in Section 6.5.2.1.1 and send the SIP INFO request as specified in Section 6.1.5.1.

6.5.2.1.1 Flash with Information

The FAP shall construct a SIP INFO request as specified in Section 6.1.4.1 and shall encapsulate the A1 Flash with Information message in the FemtoInterfaceMsg body.

The FemtoInterfaceMsg body shall be constructed as specified in Section 6.1.1. The Flash with Information Information Elements are specified in [A.S0014].

6.5.2.2 FCS procedures

Upon receiving an initial SIP INVITE request that contains a TLDN assigned by the FCS, the FCS shall verify that the MS identified by the MDN of the called party number associated with the TLDN is still served by the FCS.

If the MS is no longer being served by the FCS, the FCS shall send a SIP 487 (Request Terminated) response in response to the SIP INVITE request.

If the MS is not on an active call, the FCS shall follow the FCS Procedures for Call Termination as specified in [X.S0059-200].

1 If the MS is on an active call and either CW is inactive or CW has been invoked or 3WC has
 2 been invoked, the FCS shall send a SIP 486 (Busy here) message in response to the SIP
 3 INVITE request.
 4

5 If the MS is on an active call and CW is active, the FCS shall:
 6

- 7 ▪ construct a SIP INFO request that encapsulates an A1 Flash with Information
 8 message as specified in Section 6.5.2.2.1, excluding the Tag IE and including the
 9 following information records in the MS Information Records IE:
 - 10 – Calling Party Number Information Record populated with the contents of the
 11 P-Asserted-Identity header from the received SIP INVITE request;
 - 12 – Signal Information Record with SIGNAL_TYPE = “00” (tone signal) and
 13 SIGNAL = “001001” (Call waiting tone on);
 - 14 – optionally, Call Waiting Indicator Information Record with
 15 CALL_WAITING_INDICATOR = “1”;
- 16 ▪ send the SIP INFO request to the FAP as specified in Section 6.1.5.2; and
 17
- 18 ▪ start timers T_{cw-1} and T_{cw-2} .
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 21

22 If the FCS receives a SIP non-2xx message in response to the SIP INFO request sent by the
 23 FCS, the FCS shall follow the procedures for expiration of timer T_{cw-2} .
 24

25 Upon receiving a SIP INFO request with the Flash with Information Message Type in the
 26 FemtoInterfaceMsg body from the FAP when CW has been invoked, the FCS shall verify the
 27 SIP INFO request is formatted as specified in Section 6.5.2.1.1. If the received SIP INFO
 28 request is formatted as specified, the FCS shall:
 29

- 30 ▪ stop timers T_{cw-1} and T_{cw-2} ;
- 31 ▪ send a SIP 200 (OK) response to the FAP;
- 32 ▪ if the FCS included the Call Waiting Indicator Information Record in the SIP INFO
 33 request sent to the FAP:
 - 34 – construct a SIP INFO request that encapsulates an A1 Flash with Information
 35 message as specified in Section 6.5.2.2.1, excluding the Tag IE and including
 36 the Call Waiting Indicator Information Record with
 37 CALL_WAITING_INDICATOR = “0” in the MS Information Records IE; and
 - 38 – send the SIP INFO request to the FAP as specified in Section 6.1.5.2;
- 39 ▪ send a SIP re-INVITE request in the dialog for the active call containing an SDP
 40 offer with “a=inactive” for the media stream and set the associated media stream to
 41 inactive;
- 42 ▪ upon receiving a SIP 200 (OK) response in response to the SIP re-INVITE request:
 - 43 – send a SIP ACK request in response;
 - 44 – send a SIP re-INVITE request to the FAP containing the SDP offer received in
 45 the initial SIP INVITE request;
 - 46 – upon receiving a SIP 200 (OK) response in response to the SIP re-INVITE
 47 request:
 - 48 ○ send a SIP 200 (OK) response to the OEP containing the SDP answer
 49 received in the SIP 200 (OK) response from the FAP; and
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- upon receiving a SIP ACK request in response to the SIP 200 (OK) response, send a SIP ACK request to the FAP;

otherwise (the received SIP INFO request is not formatted as specified), the FCS shall send a SIP 400 (Bad Request) response to the FAP.

Upon expiration of timer T_{cw-1} , the FCS shall:

- construct a SIP INFO request that encapsulates an A1 Flash with Information message as specified in Section 6.5.2.2.1, excluding the Tag IE and including the following information records in the MS Information Records IE:
 - Calling Party Number Information Record populated with the contents of the P-Asserted-Identity header from the received SIP INVITE request;
 - Signal Information Record with SIGNAL_TYPE = “00” (tone signal) and SIGNAL = “001001” (Call waiting tone on);
 - optionally, Call Waiting Indicator Information Record with CALL_WAITING_INDICATOR = “1”;
- send the SIP INFO request to the FAP as specified in Section 6.1.5.2; and
- restart timer T_{cw-1} .

Upon expiration of timer T_{cw-2} , the FCS shall:

- stop timer T_{cw-1} ;
- construct a SIP INFO request that encapsulates an A1 Flash with Information message as specified in Section 6.5.2.2.1, excluding the Tag IE and including the following information records in the MS Information Records IE:
 - Signal Information Record with SIGNAL_TYPE = “00” (tone signal) and SIGNAL = “000111” (Confirm tone on);
 - if the FCS included the Call Waiting Indicator Information Record in the SIP INFO request previously sent to the FAP, Call Waiting Indicator Information Record with CALL_WAITING_INDICATOR = “0”;
- send the SIP INFO request to the FAP as specified in Section 6.1.5.2;
- perform the procedures for “MSC Initiating a Redirection Request” (with the RedirectionReason parameter set to *No answer*) as specified in [X.S0004-640];
- upon receiving a SIP CANCEL request from the MGCF in the same dialog as the initial SIP INVITE request:
 - send a SIP 487 (Request Terminated) response in response to the initial SIP INVITE request; and
 - send a SIP 200 (OK) response in response to the SIP CANCEL request.

6.5.2.2.1 Flash with Information

The FCS shall construct a SIP INFO request as specified in Section 6.1.4.2 and shall encapsulate the A1 Flash with Information message in the FemtoInterfaceMsg body.

The FemtoInterfaceMsg body shall be constructed as specified in Section 6.1.1. The Flash with Information Information Elements are specified in [A.S0014].

6.5.3 Three-Way Calling (3WC)

6.5.3.1 FAP procedures

Upon receiving a 1x Flash With Information message from the MS during an active call, the FAP shall:

- construct a SIP INFO request that encapsulates a Flash with Information message as specified in Section 6.5.2.1.1, including any received information records in the MS Information Records IE of the encapsulated A1 Flash with Information message; and
- send the SIP INFO request as specified in Section 6.1.5.1.

If the FAP receives a SIP non-2xx message in response to the SIP INFO request, the FAP shall terminate this procedure.

Upon receiving a SIP re-INVITE request containing an SDP offer that modifies an existing media stream [RFC 3264], the FAP shall:

- if the SDP offer contains the “a=inactive” attribute for the active media stream:
 - respond with a SIP 200 (OK) response containing an SDP answer with “a=inactive”;
 - set the associated media stream to the mode sent in the SDP answer;
- if the SDP offer contains the “a=sendonly” attribute for the active media stream:
 - respond with a SIP 200 (OK) response containing an SDP answer with “a=recvonly”;
 - set the associated media stream to the mode sent in the SDP answer;
- if the SDP offer contains the “a=sendrecv” attribute for the inactive media stream:
 - respond with a SIP 200 (OK) response containing an SDP answer with “a=sendrecv”;
 - set the associated media stream to the mode sent in the SDP answer;
- if the SDP offer modifies any other characteristics of the session:
 - respond with a SIP 200 (OK) response containing an SDP answer with the session description for the media stream associated with the MS user; and
 - modify the characteristics of the session in accordance with the SDP answer.

6.5.3.2 FCS procedures

6.5.3.2.1 MS User Flash – remote user on Hold

Upon receiving a SIP INFO request with the Flash with Information Message Type in the FemtoInterfaceMsg body from the FAP, the FCS shall verify the SIP INFO request is formatted as specified in Section 6.5.2.1.1. If the received SIP INFO request is formatted as specified, the FCS shall send a SIP 200 (OK) response in response to the SIP INFO request.

If 3WC is not active and CW has not been invoked,, the FCS shall terminate this procedure.

If 3WC is active and CW has not been invoked, the FCS shall:

- send a SIP re-INVITE request to the OEP containing an SDP offer with “a=inactive” for the media stream and set the associated media stream to inactive; and
- send a SIP re-INVITE request to the FAP containing an SDP offer with “a=inactive” for the media stream and set the associated media stream to inactive.

Upon receiving a SIP 200 (OK) response containing an SDP answer in response to a SIP re-INVITE request, the FCS shall send a SIP ACK request in response.

6.5.3.2.2 MS User Flash – dial third party

Upon receiving a subsequent SIP INFO request with the Flash with Information Message Type in the FemtoInterfaceMsg body from the FAP, the FCS shall verify the SIP INFO request is formatted as specified in Section 6.5.2.1.1. If the received SIP INFO request is formatted as specified, the FCS shall send a SIP 200 (OK) response in response to the SIP INFO request.

If CW has been invoked, the flash request shall be processed as part of CW treatment.

If the encapsulated A1 Flash with Information message contains a non-null Called Party Number information record in the MS Information Records IE, the FCS shall:

- analyze the MS dialed digits;

Note: If the dialed digits correspond to an Emergency Call then see Section 8.9 of [X.S0059-200].

- construct an initial SIP INVITE request in accordance with the following requirements:
 - the Request-URI shall be set to a SIP URI where the user part contains the called party number and the domain name is the home network domain of the FCS;
 - the From header field shall be set to the SIP URI of the FAP;
 - the To header field shall be set to the same value as the Request-URI;
 - the Contact header field shall be set to include the SIP URI of the FCS;
 - the P-Asserted-Identity header field shall be set to either the registered Public User Identity of the FAP or the registered public identity (i.e., MDN in tel URI format) of the calling party;
 - the P-Preferred-Identity header field shall be set to either the registered Public User Identity of the FAP or the registered public identity (i.e., MDN in tel URI format) of the calling party;
 - the P-Served-User header field shall be set to the registered Public User Identity of the FAP;
 - the Allow header field shall include the PRACK and UPDATE methods;
 - the Supported header field shall contain the option tag “100rel” (indicating support of SIP Provisional Response Acknowledgment as described in [RFC 3262]);
 - the SIP INVITE request shall not contain an SDP offer; and
- send the SIP INVITE request following the procedures for an Application Server acting as an originating UA as specified in [TS 24.229];

otherwise (the A1 Flash with Information message does not contain Called Party Number information), the FCS shall:

- send a SIP re-INVITE request to the FAP containing an SDP offer with “a=sendrecv” for the media stream and set the associated media stream to active;
- send a SIP re-INVITE request to the OEP containing an SDP offer with “a=sendrecv” for the media stream and set the associated media stream to active;
- upon receiving a SIP 200 (OK) response in response to a SIP re-INVITE request, send a SIP ACK request in response; and
- terminate this procedure upon sending a SIP ACK request to both endpoints.

Upon receiving an SDP offer in either a SIP (18x) or SIP 200 (OK) response, the FCS shall:

- inspect the SDP offer and may modify the SDP offer based on operator policy;
- store the SDP offer for the third party (SDP-U2) received from the OEP;
- construct a SIP re-INVITE request containing SDP-U2;
- send the SIP re-INVITE request to the FAP;
- upon receiving a SIP 200 (OK) response containing an SDP answer from the FAP in response to the SIP re-INVITE request:
 - store the SDP answer for the MS user received from the FAP (SDP-U1) in the SIP 200 (OK) response;
 - send a SIP ACK request in response to the FAP;
 - if the SDP offer was contained in a SIP (18x) response and the option tag 100rel was included in the Supported or Require header field:
 - send a SIP PRACK request containing the SDP answer received from the FAP (SDP-U1) to the OEP;
 - upon receiving a SIP 200 (OK) response in response to the SIP INVITE request, send a SIP ACK request to the OEP;
 - otherwise:
 - send a SIP ACK request containing the SDP answer received from the FAP (SDP-U1) to the OEP.

If the FCS receives a SIP INFO request with the Flash with Information Message Type in the FemtoInterfaceMsg body from the FAP in the same dialog at any time prior to sending the SIP ACK request, the FCS shall send a SIP 200 (OK) response in response to the SIP INFO request. The FCS may ignore the request to terminate the call to the dialed third party or the FCS may send a SIP CANCEL to the third party to terminate the call setup to the third party.

6.5.3.2.3 MS User Flash – connect all parties

Upon receiving a subsequent SIP INFO request with the Flash with Information Message Type in the FemtoInterfaceMsg body from the FAP in the same dialog after the second call has been connected, the FCS shall verify the SIP INFO request is formatted as specified in Section 6.5.2.1.1. If the received SIP INFO request is formatted as specified, the FCS shall send a SIP 200 (OK) response in response to the SIP INFO request.

The FCS shall (in order to bridge all parties into the session):

- construct an initial SIP INVITE request as specified in Section 6.5.3.2.3.1;
- send the SIP INVITE request to the media server following the procedures for an Application Server acting as an originating UA as specified in [TS 24.229];
- upon receiving a SIP 200 (OK) response in response to the SIP INVITE request:
 - construct a SIP re-INVITE request containing the SDP offer from the media server received in the SIP 200 (OK) response;
 - send the SIP re-INVITE request to the FAP;
- upon receiving a SIP 200 (OK) response in response to the SIP re-INVITE request:
 - send a SIP ACK request in response to the media server containing the SDP answer for the FAP (SDP-FAP) received in the SIP 200 (OK) response; and
 - send a SIP ACK request in response to the FAP.

In order to connect the held party into the session, the FCS shall:

- construct an initial SIP INVITE request as specified in Section 6.5.3.2.3.1;
- send the SIP INVITE request to the media server following the procedures for an Application Server acting as an originating UA as specified in [TS 24.229];
- upon receiving a SIP 200 (OK) response in response to the SIP INVITE request:
 - construct a SIP re-INVITE request containing the SDP offer from the media server received in the SIP 200 (OK) response;
 - send the SIP re-INVITE request to the OEP for the held party;
- upon receiving a SIP 200 (OK) response in response to the SIP re-INVITE request:
 - send a SIP ACK request in response to the media server containing the SDP answer for the held party (SDP-U1); and
 - send a SIP ACK request in response to the held party.

In order to connect the third party into the session, the FCS shall:

- construct an initial SIP INVITE request as specified in Section 6.5.3.2.3.1;
- send the SIP INVITE request to the media server following the procedures for an Application Server acting as an originating UA as specified in [TS 24.229];
- upon receiving a SIP 200 (OK) response in response to the SIP INVITE request:
 - construct a SIP re-INVITE request containing the SDP offer from the media server received in the SIP 200 (OK) response;
 - send the SIP re-INVITE request to the OEP for the third party;
- upon receiving a SIP 200 (OK) response in response to the SIP re-INVITE request:
 - send a SIP ACK request in response to the media server containing the SDP answer for the third party (SDP-U2); and
 - send a SIP ACK request in response to the third party.

6.5.3.2.3.1 Construction of SIP INVITE request to media server

The FCS shall construct the initial SIP INVITE request for the media server in accordance with the following requirements:

- the Request-URI shall be set to the SIP URI of a media server with a unique “ConfID” value in the user part (note: how the FCS obtains the address of the media server is outside the scope of this specification);
- the From header field shall be set to the SIP URI of the FAP;
- the To header field shall be set to the same value as the Request-URI;
- the Contact header field shall be set to include the SIP URI of the FCS;
- the P-Asserted-Identity header field shall be set to either the registered Public User Identity of the FAP or the registered public identity (i.e., MDN in tel URI format) of the calling party;
- the P-Preferred-Identity header field shall be set to either the registered Public User Identity of the FAP or the registered public identity (i.e., MDN in tel URI format) of the calling party;
- the P-Served-User header field shall be set to the registered Public User Identity of the FAP; and
- the SIP INVITE request shall not contain an SDP offer.

6.5.3.2.4 MS User Flash – release third party

Upon receiving a subsequent SIP INFO request with the Flash with Information Message Type in the FemtoInterfaceMsg body from the FAP in the same dialog after the three parties have been bridged, the FCS shall verify the SIP INFO request is formatted as specified in Section 6.5.2.1.1. If the received SIP INFO request is formatted as specified, the FCS shall send a SIP 200 (OK) response in response to the SIP INFO request.

The FCS shall (in order to release the third party):

- send a SIP BYE request to the OEP for the third party;
- upon receiving a SIP 200 (OK) response from the OEP in response to the SIP BYE, send a SIP BYE request to the media server;
- upon receiving a SIP 200 (OK) response from the media server in response to the SIP BYE, send an offerless SIP re-INVITE request to the original OEP;
- upon receiving a SIP 200 (OK) response from the OEP in response to the SIP re-INVITE request, send a SIP re-INVITE request to the FAP containing the SDP offer from the received SIP 200 (OK) response;
- upon receiving a SIP 200 (OK) response from the FAP in response to the SIP re-INVITE request, send a SIP ACK request containing the SDP answer from the received SIP 200 (OK) response to the OEP; and
- send a SIP ACK request to the FAP.

6.6 Other Services

6.6.1 Message Waiting Notification (MWN)

6.6.1.1 FAP procedures

Upon receiving a SIP MESSAGE request with Feature Notification Message Type in the FemtoInterfaceMsg body from the FCS, the FAP shall verify the SIP MESSAGE is formatted as specified in Section 6.6.1.2.1.

If the received SIP MESSAGE is formatted as specified, the FAP shall:

- send a SIP 200 (OK) response to the FCS;
- send a 1x Feature Notification message as specified in [C.S0005] to the MS identified in the To header of the SIP MESSAGE request, including the information records from the MS Information Records IEs in the encapsulated A1 Feature Notification message;
- upon receiving a Layer 2 Ack from the MS (as specified in [C.S0005]):
 - construct a SIP MESSAGE request that encapsulates a Feature Notification Ack message as specified in Section 6.6.1.1.1; and
 - send the SIP MESSAGE request as specified in Section 6.1.3;

otherwise (the received SIP MESSAGE is not formatted as specified), the FAP shall send a SIP 400 (Bad Request) response to the FCS.

Upon receiving a SIP INFO request with Flash with Information Message Type in the FemtoInterfaceMsg body from the FCS, the FAP shall verify the SIP INFO request is formatted as specified in Section 6.6.1.2.2.

If the received SIP MESSAGE is formatted as specified, the FAP shall:

- send a SIP 200 (OK) response to the FCS;
- send a 1x Flash With Information message as specified in [C.S0005] to the MS identified in the To header of the SIP INFO request, including the information records from the MS Information Records IEs in the encapsulated A1 Flash with Information message;
- upon receiving a Layer 2 Ack from the MS (as specified in [C.S0005]):
 - construct a SIP INFO request that encapsulates a Flash with Information Ack message as specified in Section 6.6.1.1.2; and
 - send the SIP INFO request as specified in Section 6.1.5.1;

otherwise (the received SIP INFO request is not formatted as specified), the FAP shall send a SIP 400 (Bad Request) response to the FCS.

6.6.1.1.1 Feature Notification Ack

The FAP shall construct a SIP MESSAGE request as specified in Section 6.1.2 and shall encapsulate the Feature Notification Ack message in the FemtoInterfaceMsg body.

The FemtoInterfaceMsg body shall be constructed as specified in Section 6.1.1. The Feature Notification Ack Information Elements are specified in [A.S0014].

6.6.1.1.2 Flash with Information Ack

The FAP shall construct a SIP INFO request as specified in Section 6.1.4.1 and shall encapsulate the Flash with Information Ack message in the FemtoInterfaceMsg body.

The FemtoInterfaceMsg body shall be constructed as specified in Section 6.1.1. The Flash with Information Ack Information Elements are specified in [A.S0014].

6.6.1.2 FCS procedures

Upon receiving a QualificationDirective INVOKE, the FCS shall follow the procedures for “MSC Receiving QualificationDirective INVOKE” as specified in [X.S0004-640].

If the MS has been handed off and the FCS is acting as the Anchor MSC or if the FCS responds with a RETURN ERROR as the result of processing the QualificationDirective INVOKE, then the FCS shall terminate this procedure.

If the MS is not on an active call, the FCS shall:

- construct a SIP MESSAGE request that encapsulates a Feature Notification message as specified in Section 6.6.1.2.1, including a Tag IE and the MessageWaitingNotificationType and MessageWaitingNotificationCount parameters from the QualificationDirective INVOKE as MS Information Records IEs;
- send the SIP MESSAGE request to the FAP as specified in Section 6.1.3;
- start timer T_{63} [A.S0014];
- upon receiving a SIP MESSAGE request with the Feature Notification Ack Message Type in the FemtoInterfaceMsg body from the FAP, the FCS shall verify the SIP MESSAGE is formatted as specified in Section 6.6.1.1.1;
 - if the received SIP MESSAGE is formatted as specified:
 - stop timer T_{63} ; and
 - send a SIP 200 (OK) response to the FAP;
 - otherwise (the received SIP MESSAGE is not formatted as specified):
 - stop timer T_{63} ; and
 - send a SIP 400 (Bad Request) response to the FAP;
- upon expiration of timer T_{63} , the FCS may optionally resend the SIP MESSAGE containing the Feature Notification message a configurable number of times;

If the MS is on an active call, the FCS shall:

- construct a SIP INFO request that encapsulates a Flash with Information message as specified in Section 6.6.1.2.2, including a Tag IE and the MessageWaitingNotificationType and MessageWaitingNotificationCount parameters from the QualificationDirective INVOKE as MS Information Records IEs;
- send the SIP INFO request to the FAP as specified in Section 6.1.5.2;
- start timer T_{63} [A.S0014];
- upon receiving a SIP INFO request with the Flash with Information Ack Message Type in the FemtoInterfaceMsg body from the FAP, the FCS shall verify the SIP INFO request is formatted as specified in Section 6.6.1.1.2;

- if the received SIP INFO request is formatted as specified:
 - stop timer T_{63} ; and
 - send a SIP 200 (OK) response to the FAP;
- otherwise (the received SIP INFO is not formatted as specified):
 - stop timer T_{63} ; and
 - send a SIP 400 (Bad Request) response to the FAP;
- upon expiration of timer T_{63} , the FCS may optionally resend the SIP INFO request containing the Flash with Information message a configurable number of times.

6.6.1.2.1 Feature Notification

The FCS shall construct a SIP MESSAGE request as specified in Section 6.1.2 and shall encapsulate the Feature Notification message in the FemtoInterfaceMsg body.

The FemtoInterfaceMsg body shall be constructed as specified in Section 6.1.1. The Feature Notification Information Elements are specified in [A.S0014].

6.6.1.2.2 Flash with Information

The FCS shall construct a SIP INFO request as specified in Section 6.1.4.2 and shall encapsulate the Flash with Information message in the FemtoInterfaceMsg body.

The FemtoInterfaceMsg body shall be constructed as specified in Section 6.1.1. The Flash with Information Information Elements are specified in [A.S0014].

7 Timer Definitions

Table 1 Timer Values

Timer Name	Default Value	Range of Values	Granularity (seconds)	Section Reference
T _{cw-1}	6	0-10	1	6.5.2.2
T _{cw-2}	30	1-60	1	6.5.2.2